excelerate energy®

Aguirre Offshore GasPort Project

Docket No. CP13-__-000

Resource Report 1 – General Project Description

April 2013

Aguirre Offshore GasPort Project

Resource Report 1 – General Project Description

Resource Report 1 Filing Requirements	
Information	**Location in Resource Report**
Minimum Filing Requirements	
1. Provide a detailed description and location map of the project facilities. (§ 380.12(c)(1)) • Include all pipeline and aboveground facilities. • Include support areas for construction or operation. • Identify facilities to be abandoned.	Section 1.3 and Figures1-2 and 1-8
2. Describe any non-jurisdictional facilities that would be built in association with the project.(§ 380.12(c)(2)) • Include auxiliary facilities (See § 2.55(a)). • Describe the relationship to the jurisdictional facilities. • Include ownership, land requirements, gas consumption, megawatt size, construction status, and an update of the latest status of Federal, state, and local permits/approvals. • Include the length and diameter of any interconnecting pipeline. • Apply the four-factor test to each facility (see § 380.12(c)(2)(ii)).	Section 1.12
3. Provide current original U.S. Geological Survey (USGS) 7.5-minute-series topographic maps with mileposts showing the project facilities. (§ 380.12(c)(3)) • Maps of equivalent detail are acceptable if legible (check with staff) • Show locations of all linear project elements, and label them. • Show locations of all significant aboveground facilities, and label them.	Figures 1-2 and 1-9
4. Provide aerial images or photographs or alignment sheets based on these sources with mileposts showing the project facilities. (§ 380.12(c)(3)) • No more than 1-year old • Scale no smaller than 1:6,000	Figure 1-10
5. Provide plot/site plans of compressor stations showing the location of the nearest noise sensitive areas (NSA) within 1 mile. (§ 380.12(c)(3,4)) • Scale no smaller than 1:3,600 • Show reference to topographic maps and aerial alignments provided above.	Not Applicable
6. Describe construction and restoration methods. (§ 380.12(c)(6)) • Include this information by milepost • Make sure this is provided for offshore construction as well. For the offshore this information is needed on a mile-by-mile basis and will require completion of geophysical and other surveys before filing.	Section 1.6

Resource Report 1 Filing Requirements	
Information	**Location in Resource Report**
7. Identify the permits required for construction across surface waters. (§ 380.12(c)(9)) • Include the status of all permits. • For construction in the federal offshore area be sure to include consultation with the MMS File with the MMS for rights-of-way grants at the same time or before you file with the FERC.	Section 1.10
8. Provide the names and address of all affected landowners and certify that all affected landowners will be notified as required in § 157.6(d). (§ 380.12(c)(10)) • Affected landowners are defined in § 157.6(d) • Provide an electronic copy directly to the environmental staff.	Section 1.11
Additional Information Often Missing and Resulting in Data Requests	
Describe all authorizations required to complete the proposed action and the status of applications for such authorizations.	Section 1.10
Provide Plot/site plans of all other aboveground facilities that are not completely within the right-of-way.	Not Applicable
Provide detailed typical construction right-of-way cross-section diagrams showing information such as widths and relative locations of existing rights-of-way, new permanent right-of-way, and temporary construction right-of-way. See Resource Report 8.	Not Applicable
Summarize the total acreage of land affected by construction and operation of the project.	Section 1.4 Table 1-1
If Resource Report 5, Socioeconomics is not provided, provide the start and end dates of construction, the number of pipeline spreads that would be used, and the workforce per spread.	Provided in Resource Report 5
Send two (2) additional copies of topographic maps and aerial images/photographs directly to the environmental staff of the Office of Energy Projects (OEP).	Provided under separate cover
Environmental Information Requests dated April 10, 2012	
1. Section 1.2 states that the Puerto Rico Electric Power Authority (PREPA) selected Excelerate Energy L.P. (Excelerate) through an Expression of Interest and Pre-Qualification process. Provide additional information related to the PREPA selection process, including the criteria examined and a timeline that indicates when Excelerate approached PREPA and when PREPA awarded the project. (Section 1.2, Purpose and Need)	Section 1.2
2. Provide information about the metocean data that was examined for the project. This should include minimum, maximum, and average wave heights and wind speeds and a discussion of the yearly, monthly, and daily variations in the project area. (Section 1.2, Purpose and Need)	Section 1.3.1
3. Provide a table that shows the temporary and permanent acreage impact associated with each component of the project including the offshore marine terminal, offshore pipeline, contractor yards and pipe storage areas. (Section 1.4, Land Requirements)	Table 1-1

Resource Report 1 Filing Requirements	
Information	**Location in Resource Report**
4. Provide a detailed proposed construction schedule by project component that includes the terminal, offshore pipeline, and onshore facilities. (Section 1.5.1, Project Schedule)	Table 1-2
5. Section 1.5.2.4 introduces the bottom-tow technique that Excelerate proposes to use to lay the subsea pipeline, and indicates that the pipeline would be pushed or pulled from the point of intersection. Explain if any barges or other equipment would be used to lay the subsea pipeline and if Excelerate would install cover or matting over the pipeline in addition to the proposed concrete coating. (Section 1.5.2.4, Subsea Interconnecting Pipeline)	Section 1.6.2.4
6. Expand section 1.5.2.4 to provide details of the proposed hydrostatic testing. For example, what screen size would be used on the water intake? What would the rate of intake be and how long would it take to fill the pipe with test water? Would the hydrostatic test water be treated at any time? Reference any applicable U.S. Department of Transportation regulations governing the hydrostatic testing process. (Section 1.5.2.4, Hydrostatic Testing)	Section 1.6.2.4
7. Confirm that the restoration plan to be developed in consultation with the Jobos Bay National Estuarine Research Reserve will be filed at the time of the formal FERC application, or sooner. (Section 1.5.3, Restoration Procedures)	Section 1.6.3
8. Provide a section in Resource Report 1 that discusses the status of field surveys. Include the geotechnical, marine and benthic, and cultural resources surveys. Discuss the consultation and permitting processes that have been completed to conduct the surveys and provide the schedule for completing the surveys.	Section 1.5
9. Table 1.6-1 indicates that 1.9 million gallons per day of water would be used as ballast water on the floating storage and regasification unit (FSRU). Clarify if the FSRU would require 1.9 million gallons per day year round or only when the FSRU is offloading natural gas. (Section 1.6.3.4, FSRU Water Use)	Section 1.7.3.4
10. Section 1.6.5 states that depending on the particular liquefied natural gas (LNG) carriers offloading at the GasPort, an estimated combined 16.9 to 75.3 million gallons of ballast water and engine cooling water may be taken on during LNG carriers offloading operations. Provide a table that identifies by vessel size the quantity of ballast water and engine cooling water that would be required. In addition provide information on filtration Excelerate would use on the sea chest to prevent the intake of sea organisms. (Section 1.6.5, LNG Carriers)	Section 1.7.3.4 Table 1-5

Resource Report 1 Filing Requirements	
Information	**Location in Resource Report**
11. The following comments refer to table 1.9-1: a. Rename the table to "Permits, Reviews, and Consultations for the Aguirre Offshore GasPort Project." b. The table lists three agencies with cultural resource responsibilities for the Commonwealth. Explain the role of each of the three agencies in regards to cultural resources oversight. c. Provide an additional column that specifies the regulations that support the authorizations/permits that would be required on both a federal and state level. In addition, expand the table to include the FERC's regulatory role under the Natural Gas Act, as well as the role of the Advisory Council on Historic Preservation. d. Section 1.10 states that the project would be regulated by the Puerto Rico Department of Natural and Environment Resources for its impact on territorial waters and submerged lands. Clarify if this permit is included in table 1.9-1 and revise as necessary. e. Add any consultations or permits required from the U.S. Fish and Wildlife Service regarding the Marine Mammal Protection Act.	Table 1-6
12. Provide a description of the agency consultation and public outreach process that Excelerate has implemented to inform the public about the proposed project. (Section 1.10, Affected Landowners)	Section 1.11
13. Section 1.11.1 indicates that the non-jurisdictional process gas heater/heat exchanger may result in a positive impact to Jobos Bay. Provide further information on the impact to Jobos Bay that is currently occurring from the discharge process and quantify the improvement to Jobos Bay based on the process change. (Section 1.11.1, Interconnecting Facilities)	Section 1.13.1
14. Provide additional discussion of the potential for cumulative impacts associated with current or planned activities in the vicinity of the proposed project including infrastructure projects (e.g., roads and railways), residential and commercial developments, and offshore activities (e.g., dredging projects). In addition, provide a discussion of the current transmission pipelines being considered or constructed in Puerto Rico and their potential impacts. (Section 1.12, Cumulative Impacts)	Section 1.13
15. Clarify the quantity of natural gas that will be needed to generate 1,495 megawatts of power and the quantity that will be delivered. Page 1-1 states the purpose is to deliver up to 650 million standard cubic feet per day (MMscfd) to the Aguirre GasPort Plant. Page 1-3 states that LNG can be discharged at base load rates of up to 500 MMscfd. (Section 1.2, Purpose and Need)	Section 1.2 Section 1.3.2
16. Page 1-12 states that the flow rate can be increased up to 100 MMscfd for a single pump and that it takes 5 pumps to send out 500 MMscfd and a sixth can be used for peak capacity, which would be 600 MMscfd. Page 1-1 states that delivery can be up to 650 MMscfd. Provide additional information on how the extra 50 MMscfd would be discharged. In addition, Excelerate staff stated at the Salinas scoping meeting that each pump can peak at 115 MMscfd for a maximum output of 690 MMscfd. Please clarify. (Section 1.6.3.1, FSRU)	Section 1.7.3.1
17. In regards to the Excelerate FSRU, provide the classification society(ies) that is currently used to class the Excelerate ships and the classification society that would be used to class the proposed permanently moored FSRU. (Section 1.3.2, FSRU)	Section 1.3.3

Resource Report 1 Filing Requirements	
Information	**Location in Resource Report**
18. Provide the timing for when Excelerate will decide specifically what vessel it would use for its FSRU. (Section 1.5.1, Project Schedule)	Section 1.6.1
19. Section 1.6.3.3 states that a FSRU is typically dry-docked every 5 years. Provide the length of time a ship is typically dry-docked and explain what Excelerate proposes to do during this period to supply gas to the Aguirre GasPort Plant. (Section 1.6.3.3, FSRU Maintenance)	Section 1.7.3.3
Environmental Information Requests dated October 10, 2012	
1. In addition to figure 1, include a second figure that locates the site on a larger scale map than the small location map positioned in the lower left hand corner of figure 1 (Section 1.3.1, Offshore Terminal).	Figure 1-1
2. Clarify that the temporary and permanent acreages shown in table 1-1 includes the areas that will be disturbed by anchors and cable sweep (e.g., within the 100 feet of temporary right of way as well as the offshore facility). Provide a map that shows the temporary and permanent land requirements listed in the table. (Section 1.4, Land Requirements)	Section 1.6.2.4; Section 1.4 Table 1-1; and Figure 1-8
3. According to the U.S. Army Corps of Engineers (COE), there is no obvious component of the project that would require a discharge of fill and/or dredged material within waters of the United States. If there is not, a Section 404 permit would not be required. Clarify and revise text and table 1-6 as appropriate. Also, verify that no wetlands would be affected or filled within the power plant boundary or any other on-shore project component (to include staging areas, contractor yards, etc.) (COE)	Table 1-6; Resource Report 2
4. Provide plan view drawings illustrating: a. the footprint of proposed offshore platform, including the floating storage and regasification unit (FSRU) and liquefied natural gas carrier (LNGC); b. the dimensions (length and width) and name of each proposed structure name (i.e., FSRU berth, walkway, breasting dolphins, utility platforms, control platforms); c. the distance between the proposed FSRU and La Barca Cays;	a. & b.: Figure 1-3 c.: Figure 1-8
d. the length of the subsea pipeline and footprint of the associated workspace; and	Figure 1-8 and Figure 1-9
e. the construction method for each segment of the subsea pipeline (Section 1.4, Land Requirements) (COE)	Section 1.6.2.4
5. Provide a map that identifies the areas which were included in the field survey work listed in section 1.5. Label the surveyed area for the appropriate survey. (Section 1.5, Field Surveys)	Figure 1-11
6. Table 1-2 indicates a 1-year construction period for the subsea pipeline. Provide further detail on specific construction activities and their duration. In addition, include a description of the activities and duration for the marine infrastructure and topside construction periods. Clarify if these are the only two components to be constructed in support of the offshore berthing platform. (Section 1.6.1, Project Schedule)	Section 1.6.1, Section 1.6.2.2 (platform), and Section 1.6.2.4 (subsea pipeline)

Resource Report 1 Filing Requirements	
Information	**Location in Resource Report**
7. Provide, in detail, the methodology and construction procedures proposed for the offshore berthing platform as well as subsea pipeline. Describe how the subsea pipeline would be anchored to prevent its movement during hurricane or strong sea wave events. In addition, provide information related to the number of boats in each construction activity; anchoring and cable sweep from construction boats; construction duration for each activity; location and dimensions of all on-shore work areas including lay-down areas, and staging areas, and contractor yards; and other pertinent information. (Section 1.6.2, Construction Procedures)	Section 1.6.2.2 (platform); and Section 1.6.2.4 (subsea pipeline) Table 1-1 Figure 1-8
8. Describe in more detail the construction method to be used to bring the final segment of the subsea pipeline ashore at the existing Aguirre Power Plant. Include a description of the temporary impacts in Jobos Bay, the location of the workspace for this segment as well as for the facility tie-in equipment. (Section 1.6.2, Construction Procedures)	Section 1.6.2.4
9. Aguirre states that it will determine any mitigation measures that may be required, such as subsea pipeline coverage, following the completion of the survey work and facility siting. Provide a summary of potential mitigation measure that would be utilized and/or are being considered. (Section 1.6.2, Construction Procedures)	See respective Resource Reports
10. Section 1.6.2.4 indicates that test volumes "may be up to 3 times the volume over the course of the project, or as little as 20% over the calculated volume." This could suggest that the possible minimum amount of water required is not the calculated volume but 20 percent over the calculated volume. Confirm if this is correct. (Section 1.6.2.4, Subsea Interconnecting Pipeline, Hydrostatic Testing)	Section 1.6.2.4
11. Section 1.7.3.1 states that the flow rate can be increased up to 100 million standard cubic feet per day (MMscfd) for a single pump and that it takes 5 pumps to send out 500 MMscfd and a sixth pump can be used for peak capacity, which would be 600 MMscfd. Section 1.2 states that delivery can be up to 650 MMscfd. Provide additional information on how the extra 50 MMscfd would be discharged. (Section 1.7.3.1, LNG Regasification Process)	Section 1.2
12. The metocean study only describes extreme events (e.g., tropical storms), and does not describe average conditions in the region. Provide a more detailed description of the average oceanographic conditions in the project area. (Appendix 1B, , Metocean Criteria Study)	Section 1.3.1 Resource Report 13 Appendix R.1
13. Identify any past, current, or planned navigation dredging projects within Jobos Bay and the estimated volume of sediment removed during past dredging activities. In addition, identify wastewater outfall points or other discharge locations in the project area. (Section 1.12, Cumulative Impacts)	Section 1.13.9; Section 1.13.10
14. Identify any current or planned commercial, residential, or recreational and tourism developments within the project area including the municipalities of Salinas and Guayama. (Section 1.12, Cumulative Impacts)	Section 1.13
15. Expand the discussion of recently constructed, currently under construction, or planned energy projects in the local and regional area. Include the current status of any permitting or authorizations required for these projects and their distance from the project area. (Section 1.12, Cumulative Impacts)	Section 1.13

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LIST OF ACRONYMS AND ABBREVIATIONS

Aguirre Plant	Aguirre Power Complex
AOGP	Aguirre Offshore GasPort, LLC
Bcf	billion cubic feet
BMS	berth monitoring system
CFR	Code of Federal Regulations
DCS	Distributed Control System
DOE	U.S. Department of Energy
DNER	Puerto Rico Department of Environmental and Natural Resources
DNV	Det Norske Veritas
DSME	Daewoo Shipbuilding & Marine Engineering Co., Ltd
EBRV	Energy Bridge Regasification Vessel
EI	Environmental Inspector
EOI	Expression of Interest
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESD	emergency shutdown
FERC	Federal Energy Regulatory Commission
fps	feet per second
FSA	Facility Security Assessment
FSRU	Floating Storage and Regasification Unit
HFO	Heavy Fuel Oil
HP	high pressure
HPMLA	high pressure marine loading arm
IAS	Integrated Automation System
ISM code	International Management Code for the Safe Operation of Ships and for Pollution Prevention
JBNERR	Jobos Bay National Estuarine Research Reserve
LNG	liquefied natural gas
LNGC	LNG carrier
LP	low pressure
m^3	cubic meter
MGD	million gallons per day
MMO	Marine Mammal Observer
MMscf/d	million standard cubic feet per day
MW	megawatt
NGA	Natural Gas Act
NOAA	National Oceanic and Atmospheric Administration
NSA	noise sensitive areas
NWP	Nationwide Permit
OCIMF	Oil Companies International Marine Forum
OEP	Office of Energy Projects

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

PFSP	Port Facility Security Plan
PI	point of inflection, or angle, between two straight pipeline segments
Plan	FERC staff's Upland Erosion Control, Revegetation and Maintenance Plan
PM	Project Manager
PQ	Pre-qualification
PR	Puerto Rico
PREPA	Puerto Rico Electric Power Authority
Procedures	FERC staff's Wetland and Waterbody Construction and Mitigation Procedures
Project	Aguirre Offshore GasPort Project
QC/DC-ERS	quick connect/quick disconnect and emergency release system
SIS	Safety Instrumented System
sm^3/h	standard cubic meters per hour
SSL	ship shore link
STS	ship to ship
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USGS	United States Geological Survey
WSA	Waterway Suitability Assessment

RESOURCE REPORT 1
GENERAL PROJECT DESCRIPTION

1.1 INTRODUCTION

Aguirre Offshore GasPort, LLC (AOGP), a wholly owned subsidiary of Excelerate Energy L.P. (Excelerate Energy) is proposing to develop, construct, and operate the Aguirre Offshore GasPort Project (Project) to be located in Salinas, along the southern shore of the Commonwealth of Puerto Rico in Commonwealth waters. The Project is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving and storing liquefied natural gas (LNG) to be acquired by PREPA, regasifying the LNG, and delivering natural gas to PREPA's existing Aguirre Power Complex (Aguirre Plant). The Project will include an LNG terminal and facilities that will be sited, constructed and operated pursuant to Section 3 of the Natural Gas Act (NGA), 15 U.S.C. § 717b.

The Project will utilize Excelerate Energy's proven Energy Bridge™ technology to receive, store and vaporize LNG for delivery as natural gas utilizing one of Excelerate Energy's existing Energy Bridge Regasification Vessels (EBRVs) functioning as a floating storage and regasification unit (FSRU). The FSRU will have a storage capacity of approximately 150,900 m^3 of LNG. PREPA will contract for 100% of the available capacity (storage and delivery throughput) from the FSRU. The FSRU will operate in the closed-loop regasification mode[1] and will have the capability of sustained delivery up to approximately 500 MMscf/d of natural gas and peak delivery up to approximately 600 MMscf/d. LNG will be delivered to the Project via LNG carriers (LNGCs), unloaded and stored within an FSRU[2], regasified on the FSRU, and delivered directly to the Aguirre Plant by a subsea pipeline.

This Resource Report 1, along with Resource Reports 2 through 11 and 13, will collectively make up the Environmental Report to be submitted as part of AOGP's NGA Section 3 application to the Federal Energy Regulatory Commission (FERC).

1.2 PURPOSE AND NEED

The current purpose of the Aguirre Offshore GasPort Project is to provide up to 3.2 Bcf of LNG storage capacity and sustained deliverability of 500 MMscf/d, with a peaking deliverability of up to 600 MMscf/d of natural gas directly to the 1,492 MW Aguirre Plant, which represents approximately one third of Puerto Rico's total installed generating capacity. At the time of startup of the facility, the estimated delivery flow rate for the facility will be approximately 255 MMscf/d at 100% load factor generation. PREPA will make daily nominations for the amount of stored LNG to be regasified on the FSRU, to be delivered directly to the Aguirre Plant. PREPA will contract for 100 percent of the available capacity (storage and delivery throughput) of the Project. The Project will allow PREPA to effectuate its long planned conversion of the Aguirre Plant from fuel oil only to dual-fuel generation facility, capable of burning diesel and natural gas for the combined cycle units and fuel oil and natural gas for the thermoelectric

[1] The closed-loop regasification mode does not utilize sea water in the regasification process.

[2] The facility will be designed for long-term, continuous operations. As explained below, the FSRU will be capable of maneuvering on its own away from the offshore berthing platform when necessary and will not be permanently attached to the offshore berthing platform.

plant.[3] A diversified fuel supply at the Aguirre Plant will contribute toward price stabilization, which is not enjoyed under the current supply scenario, and presents an environmentally acceptable alternative to oil in meeting the project demand.

The Project is an essential component of PREPA's fuel diversification strategy. In July 2010, Puerto Rico adopted the "Public Policy on Energy Diversification by Means of Sustainable and Alternative Renewable Energy in Puerto Rico Act" ("Energy Diversification Act "),[4] which requires that a certain portion of the energy sold comes from renewable sources. In its Statement of Motives, the Energy Diversification Act acknowledges the significant adverse effects that have arisen from Puerto Rico's dependence on imported fuel oil for power generation purposes and further notes that "the electric power cost is twice as high in Puerto Rico than the average cost thereof in the rest of the United States, and the average Puerto Rican pays about twenty cents per kilowatt-hour (kWh)." While renewable energy represents Puerto Rico's desired long-term future, PREPA's Corporate Strategic Plan 2011 – 2015 establishes the diversification of energy sources to reduce the use of fuel oils as one of its main goals and immediate tasks.

This goal has become particularly important since the U. S. Environmental Protection Agency ("EPA") published the Mercury and Air Toxics Standard ("MATS")[5], which will require PREPA to comply with lower emission levels for certain atmospheric pollutants. Noncompliance with this new standard could entail the imposition of fines or other sanctions or require PREPA to curtail the output of the Aguirre Plant, which could endanger the reliability, stability and efficiency of the island's electric system. The dual fuel capability implemented through this Project will allow the Aguirre Plant to meet the requirements of the MATS, thereby providing substantial environmental, economic and reliability benefits to the citizens of Puerto Rico.

The Project will also reduce fuel oil barge traffic in Jobos Bay. Fuel oil is currently delivered to the Aguirre Plant by barge, amounting to three to four fuel barge deliveries per week or 150 to 200 barge trips (ingress and egress) per year. After PREPA completes its conversion of the Aguirre Plant and the Project is placed into service, fuel oil barge deliveries are estimated to decline by as much as 90 percent, to 15 to 20 trips per year, due to natural gas deliveries from the Project. Consequently, using the proposed LNG Terminal (including the interconnecting subsea pipeline) to deliver natural gas to the Aguirre Plant will improve the reliability of PREPA's fuel supply and will reduce the potential for fuel spills, as well as potential encounters with certain endangered species and recreational boat traffic.

As noted, the Aguirre Plant is PREPA's largest power facility with an installed generation capacity of 1,492 MW. The 900 MW thermoelectric facilities at the Aguirre Plant currently use No. 6 Heavy Fuel Oil (HFO) as its primary fuel. Initially, the Aguirre Plant was to be supplied by a pipeline (formerly known as Gasoducto del Sur), which was to be constructed from the EcoElectrica LNG facility near Peñuelas, PR (currently the only LNG import facility on the island). In April 2009, the proposed pipeline

3 The flowing supply that will be required to generate 1,492 MW at the Aguirre power plant will be a function of the turbine, boilers and other equipment designed for the conversion.

4 S.B. 1519, Act No. 82 (approved July 19, 2010) (available through the Commonwealth's Office of Legislative Services at http://www.oslpr.org/download/en/2010/A-0082-2010.pdf).

5 *See National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standard of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units*, 77 Fed. Reg. 9304 (February 16, 2012). Certain aspects of the MATS rule are pending on reconsideration.

project was cancelled. With the proposed source of natural gas for the Aguirre Plant cancelled, PREPA began searching for alternative delivery technologies.

In order to deliver natural gas to the Aguirre Plant, PREPA sought to identify a qualified company to develop, permit, finance, construct and operate an LNG import terminal off the coast of Aguirre. PREPA would require this facility to provide natural gas to the Aguirre Plant at least 98% of the time. In December 2010, PREPA conducted an Expression of Interest (EOI) and Pre-qualification (PQ) process to identify qualified companies to develop such a facility. PREPA sought proposals and qualifications from companies that could demonstrate a proven track record to provide and operate floating LNG storage and regasification terminals. On December 21, 2010, Excelerate Energy received an invitation from PREPA to submit a technical proposal and company qualifications. Excelerate Energy accepted the invitation from PREPA and submitted their technical proposal and company qualification on January 21, 2011. To Excelerate Energy's knowledge, four companies participated in the EOI/PQ process and on February 16, 2011 PREPA announced it had selected Excelerate Energy and its proposed Aguirre Offshore GasPort Project as the most qualified company with the preferred solution.

1.3 PROPOSED FACILITIES

The Aguirre Offshore GasPort Project will consist of three main components: 1) an offshore berthing platform; 2) an offshore marine LNG receiving facility (Offshore GasPort) consisting of an FSRU moored at the offshore berthing platform; and 3) a subsea pipeline connecting the Offshore GasPort to the Aguirre Plant. The offshore berthing platform and the connecting subsea pipeline will comprise the LNG terminal facilities to be certificated in this proceeding pursuant to Section 3 of the NGA.[6] Details of each project component are described below. Figures of the Project and individual components are included at the end of this resource report.

1.3.1 Metocean Data

Following the selection by PREPA, AOGP petitioned Forristall Ocean Engineering, Inc. of Camden, Maine, to analyze metocean data and generate a report to give a complete set of metocean design specifications for the proposed project site. Excelerate purchased hindcast metocean data from Oceanweather for the proposed Project site (Oceanweather 2008) and made it available to Forristall Ocean Engineering, Inc. The hindcast is from the GROW-FINE Caribbean Project, which is a comprehensive metocean study of the Caribbean Sea. The hindcast data includes both individual tropical storms and a continuous hindcast. Tropical storms dominate extreme conditions at the site. The continuous hindcast describes the trade wind regime that dominates operational conditions at the site.

The continuous wind and wave hindcast covers a 26 year period (1980-2005). This hindcast is on a grid of 14 km spacing covering the Caribbean Sea and adjacent areas. The boundary conditions are specified from Oceanweather's North Atlantic Fine hindcast so that wave energy sources in the greater North Atlantic Basin (trade winds and extratropical storms) are accounted for.

[6] AOGP is including an FSRU as part of the Project solely to provide a comprehensive description of the Project and associated activities. As explained in the Application, Section 2(11)(A) of the NGA specifically excludes from the definition of "LNG terminal" "waterborne vessels used to deliver natural gas to and from any such facility." 15 U.S.C. § 717a(11)(A). Nothing in this report should be read as acquiescence by AOGP to any construction of this statutory language that includes the FSRU in any FERC-certificated facilities comprising the Project. In fact, AOGP expressly contends, in the Application, that the FSRU is not subject to FERC jurisidiction.

Extreme values of winds, waves and currents were calculated for both tropical storms and extra-tropical storms. Tropical storms affect the extremes during July through November. Extremes for tropical storms were calculated using the tropical storm hindcast. Extratropical extremes were calculated using the continuous hindcast data for the other seven months. To ensure reliability during all metocean conditions the basis for the GasPort design and its intended operations is based on extreme events. Therefore, AOGP evaluated the raw metocean data to determine extreme conditions, and did not evaluate the data to determine average conditions for the site. Additional evaluation of metocean data for the site is included in Resource Report 13 Appendix R.3.

Using the available metocean (wave and wind) data for the 26-year period it was determined that the proposed Offshore GasPort at the proposed site will provide the required high level of operational reliability and availability for natural gas delivery to the Aguirre Plant. The Metocean Criteria Study for the South Coast of Puerto Rico prepared by Forristall Ocean Engineering, Inc., is provided as Appendix 1A to this resource report.

1.3.2 Offshore Berthing Platform

The offshore berthing platform will be installed in Commonwealth waters approximately 3 miles offshore of the Aguirre Plant (as measured in a straight line from the offshore berthing platform to the pipeline landfall at the Aguirre Plant) and about 0.6 mile outside of the barrier islands Cayos de Barca and Jobos Bay (Figures 1-1 and 1-2). The offshore berthing platform will be designed for long-term mooring of an FSRU and for receipt of LNGCs ranging in size from 125,000 cubic meters (m^3) of storage up to a Q-Flex[7]size (217,000-m^3) LNGC.

Criteria used by AOGP for siting the offshore berthing platform include:

- Avoid or minimize effects to known sensitive seabed habitat;
- A minimum 10% under keel clearance based on maximum vessel draft shall be maintained;
- Avoid populated areas taking into account safety exclusion zones as currently required by the United States Coast Guard (USCG);
- Close proximity to existing shipping lanes but minimize impact on commercial and/or recreational vessel traffic;
- Metocean conditions (wind and waves) that will minimize potential downtime to meet PREPA-required operational reliability; and
- Close proximity to the existing Aguirre Plant to minimize pipeline length.

The offshore berthing platform will be a fixed platform carrying all the topside facilities and two berths, one on each side ("across the dock" configuration) of the fixed platform. One of Excelerate Energy's existing EBRVs will be moored at a berth on the north (landward) side of the platform and serve as the FSRU. LNGCs will temporarily dock on the south (seaward) side of the platform while unloading LNG cargo. A drawing of the offshore terminal is shown in Figure 1-3. Modeled renderings of the facility are shown on Figures 1-4, 1-5, and 1-6. Cargo will be transferred from the LNGC via the topside conventional LNG loading arms and cryogenic piping to the FSRU for storage. The FSRU will provide the equivalent of 3.2 billion cubic feet (Bcf) of natural gas storage capacity in liquid form (150,900 m^3 of

[7] The 'Q-Flex sized' vessels is an industry accepted reference for any LNG carriers with a cargo capacity in the range of 210,000 to 217,000 m^3. Qatar Gas was the first to build this size of vessel and therefore the 'Q' comes from Qatar.

LNG) and will be capable of discharging regasified LNG at a contractually guaranteed sustained rate of up to 500 MMscf/d, with peaking rates of up to 600 MMscf/d.

Specific components of the proposed offshore berthing platform include:

- Two LNG vessel berths;
- Berthing fenders and mooring and breasting dolphins for each berth;
- LNG loading arms at each berth, and LNG drain tanks and LNG piping between the LNG loading arms at each berth to facilitate transfer of LNG between vessels;
- High Pressure Gas Loading Arms at one berth to connect to the FSRU and facilitate natural gas discharge to the send-out pipeline;
- Utility platforms housing docking facilities for life boat and service vessels, control and switch gear rooms, utility equipment, personnel access/egress and laydown and work areas; and
- Utility systems, including gas and diesel fueled electricity generators, nitrogen generators, electric sea water pumps, diesel fire pumps, diesel storage tanks, lubrication oil storage tanks, potable water and waste water tanks, sewage treatment unit, and fire water monitors. Process support systems, electrical systems, lifting and handling, and safety systems.

The discharge of natural gas (regasified LNG) to shore will be facilitated by the FSRU systems via the high pressure gas manifold and the platform-mounted high pressure gas loading arms into the subsea pipeline. There will be no trestle or above-water connection between the Offshore GasPort and shore.

1.3.3 Floating Storage and Regasification Unit (FSRU)

AOGP will utilize one of Excelerate Energy's existing EBRVs as the FSRU for the Project. EBRVs are purpose-built LNG tankers that incorporate onboard equipment for the vaporization of LNG and delivery of high-pressure natural gas. EBRVs utilize a steam generating plant in the vessel for propulsion and overall vessel operations. These vessels were developed jointly by Excelerate Energy, Exmar NV, and Daewoo Shipbuilding & Marine Engineering Co., Ltd (DSME). Excelerate Energy currently has eight EBRVs in its fleet, all of which are classified under survey of Bureau Veritas classification society, and a ninth is under construction for a project in South America. Construction of a new FSRU for this Project will not be required. The EBRV placed into service for the proposed Project will have a storage capacity of up to 150,900 m^3 of LNG, an overall length of 291 meters, and a design draft of 11.6 meters. The EBRV Excelsior is shown in Figure 1-7.

The FSRU for the proposed Project will be subject to and will comply with USCG Subchapter O Endorsement and Port State Inspections for a foreign flag vessel operating in U.S. waters. The vessels delivering LNG to the Offshore GasPort will be conventional LNGCs which could include vessels owned and operated by Excelerate Energy or by other third-party LNGC owners/operators. These LNGCs will also comply with applicable Class, USCG, and Port State requirements.

The containment system for the EBRV considered for use at the Offshore GasPort is a Membrane Cargo Containment System, which are reinforced tanks with a membrane of high nickel alloy stainless steel and an insulation system that allows greater resistance to liquid sloshing during adverse sea conditions, if the EBRV needs to depart the offshore berthing platform.

1.3.4 Subsea Interconnecting Pipeline

An 18-inch outside diameter natural gas pipeline with concrete coating[8] operating at an MAOP of 100 bar[9] will be installed to connect the Offshore Terminal to the existing Aguirre Plant. The proposed pipeline route extends approximately 4.1 miles from the proposed GasPort located outside of Jobos Bay (Mile Post (MP) 0) extending through the Boca del Inferno inlet (MP 1.0 to ~MP 1.8) and extending across the basin of Jobos Bay (MP 1.8 to MP 4.0) to the Aguirre Plant property where it will interconnect with power plant piping (Figure 1-2). The pipeline route was selected according to the following criteria:

- Avoid mangrove barrier islands;
- Minimize proximity to known sensitive bottom habitats;
- Minimize bends, or points of inflection (PI), to facilitate offshore installation methods with the least bottom impacts;
- Avoid crossing of existing barge channel in Jobos Bay;
- Avoid crossing of existing Aguirre Plant cooling water outfall pipe;
- Direct landfall within the Aguirre Plant to avoid private properties; and
- Shortest reasonable route between the Offshore GasPort and Aguirre Plant.

1.4 LAND REQUIREMENTS

The proposed Project will only affect a small upland area within the Aguirre Plant property, since the facility will be primarily subsea and offshore. Based on an assumed pipeline construction right-of-way width of 100 feet and the area required for the proposed offshore berthing platform, the area requested for approval for construction impacts is approximately 158 acres. Submerged land requirements for operation are anticipated to be approximately 32 acres.

The temporary and permanent land requirements requested as part of AOGP's application are listed in Table 1-1 and shown on Figure 1-8. A plan view drawing of the berthing platform is shown on Figure 1-3. Detailed pipeline drawings are included in Figures 1-9 and 1-10.

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8 The steel pipeline outside diameter will be 18-inches. A three-inch thick concrete coating will be applied to the pipe prior to installation, resulting in a final diameter of approximately 24-inches.

9 Pipeline will have a design pressure of 135 bar.

Table 1-1
Land Requirements for the Aguirre Offshore GasPort Project[1]

Project Component	Temporary Land Required for Construction (acres)	Permanent Land Required During Operation (acres)
Offshore Berthing Platform[2]	74	22
Subsea Interconnecting Pipeline[3]	81	10
Temporary Staging and Support Areas[4]	1.5	0
Total	156.5	32

[1] *The proposed construction methods for the subsea interconnecting pipeline do not include use of mooring anchors or cables; therefore, no temporary workspace will be required for the sweep of mooring anchor chains or cables. Construction of the Offshore Berthing Terminal may require the use of mooring anchors; however, the temporary workspace required for the sweep of mooring anchor chains or cables is included in the total acreage calculations.*

[2] *Based on assumed construction area of 1,340 x 2,400 feet and operational right-of-way 670 x 1400 feet.*

[3] *Based on assumed construction right-of-way width of 100 feet and lay barge impact area (including temporary anchor piles) of 500 feet from the pipe centerline at selected locations as shown on Figure 1-8 and operational right-of-way width of 20 feet.*

[4] *Located on industrial land within the existing fenced Aguirre Plant property.*

Because marine construction entails some uncertainties, the area requested for construction and operation is larger than the area of seabed impacts that will actually result from construction and operation. Actual area of direct impact to the seabed during pipeline construction will be significantly less than the area requested to support construction and operation.

Along the path of the pipeline between the PIs impacts are anticipated to occur only near the footprint of the pipeline itself. For the purpose of estimating actual impacts to the seabed, it is assumed that the direct lay pipeline technique may result in direct impact on a 6-foot wide corridor along the pipeline centerline. Impacts in this 6-foot-wide corridor may result from dragging the 2-foot-wide (including concrete coating) pipeline along the bottom, and sediments pushed to the side (approximately 2 feet on either side) as the pipeline is pushed/pulled along the centerline. The actual area of seabed impact within this 6-foot-wide corridor along the 4.1 mile pipeline is approximately 3 acres. In addition to the estimated 6-foot-wide corridor where direct impact could occur, negligible to minor indirect temporary impacts may occur within an area up to approximately 7 feet wide on either side of the direct impact (14 feet total), resulting in another approximately 7 acres of temporary indirect impact during construction.

AOGP is requesting temporary workspace at each pipeline PI that includes an area within a 500 foot radius from one side of the pipeline (see Figure 1-8). Actual area of direct impact to the seabed within each of these temporary work areas will be limited to the placement of temporary piles alongside the lay barge to fix the barge in place, and placement of temporary piles to fix block and cable to push/pull the pipeline segments into place (see detailed discussion of pipeline construction further below in this Resource Report).

1.5 FIELD SURVEYS

AOGP has completed a number of field surveys of the proposed Project as described below.

On January 26, 2012, AOGP submitted geophysical survey plans to the U.S. Army Corps of Engineers (USACE) and requested authorization under Nationwide Permit (NWP) No. 6 to conduct those surveys for the Project. The geophysical surveys included detailed bathymetry, sub-bottom profile, side-scan sonar, gradiometer and vibracore sampling. On February 6, 2012, the USACE authorized the requested surveys under NWP No.6, Survey Activities. On March 22, 2012, AOGP completed geophysical surveys in the area of the proposed offshore berthing platform and within a 300-foot-wide corridor across Jobos Bay. At the conclusion of the geophysical surveys, AOGP submitted an amendment application to conduct the geotechnical investigation for the Project and received authorization to proceed on March 29, 2012. Results from the geophysical survey were utilized to develop the geotechnical investigation plans. The geotechnical investigation was conducted in July and August, 2012.

Concurrent with the NWP No. 6 application, AOGP made application to the Puerto Rico Department of Natural and Environmental Resources (DNER) to conduct benthic habitat surveys and ichthyoplankton sampling. On February 28, 2012, the DNER authorized AOGP to conduct the requested surveys, which were completed in May 2012. AOGP also conducted underwater archaeological surveys concurrent with the geophysical surveys and evaluated the gradiometer data from those surveys. AOGP also conducted baseline noise surveys in April 2012, including in-air noise measurements at potential noise sensitive areas and underwater noise surveys at the offshore berthing platform site and in Jobos Bay. AOGP has also identified locations from which the Offshore GasPort may be visible from on shore, and has collected photos and location data to support preparation of photo simulations to assess visual impacts.

The general areas covered by the field surveys are shown on Figure 1-11. Further description of each survey effort, including results and detailed maps showing survey coverage, is included as appropriate in respective resource reports.

1.6 CONSTRUCTION SCHEDULE AND PROCEDURES

1.6.1 Project Schedule

AOGP intends to request the FERC to issue authorization to site, construct, and operate the Aguirre Offshore GasPort no later than March 1, 2014. Final selection of the specific FSRU from the Excelerate Energy fleet will be made after issuance of the FERC authorization. AOGP anticipates requesting authorization to commence construction approximately one month after FERC authorization. Construction is anticipated to require approximately 12 months with the Project in service during 1st Q 2015. Table 1-2 provides additional detail for construction of each project component. The duration for construction of individual Project components is further described further below in this Resource Report. Information regarding anticipated construction workforce is included in Resource Report 5.

Table 1-2
Construction Schedule for Major Components of the Aguirre Offshore GasPort Project

Project Component	Commence Construction	Complete Construction
Marine Infrastructure [1]	April 2014	December 2014
Topsides	August 2014	March 2015
Subsea Interconnecting Pipeline	May 2014	August 2014

[1] *To consist of the support infrastructure and platform decking. The marine infrastructure, together with the topside facilities, makes up the entire offshore berthing platform.*

1.6.2 Construction Procedures

The Project will be constructed in accordance with applicable governmental regulations, permits, and approvals. Construction methods will be those that are consistent with industry-recognized practices, company policies, and best management practices. Detailed descriptions of construction methods will be prepared in construction specifications and drawings prior to the commencement of work. The majority of construction will take place in a marine environment where specialized marine construction will be required. For the small component of onshore pipeline, construction will be performed in accordance with the FERC staff's Upland Erosion Control, Revegetation and Maintenance Plan, and the Wetland and Waterbody Construction and Mitigation Procedures (FERC staff's Plan and Procedures).

AOGP will be represented on the Project site during construction by a Project Manager (PM). Supervisors and inspectors including the Environmental Inspector (EI) will assist the PM. All inspectors and supervisors will have access to the relevant compliance specifications and other documents contained in the construction contracts. To ensure that environmental conditions associated with permits or authorizations are satisfied, the EI's duties will be consistent with those contained in paragraph III.B (Responsibilities of the Environmental Inspector) of the FERC staff's Plan. The EI(s) will have authority to stop work or require other corrective action(s) to achieve environmental compliance. The EI's duties will also include training Project personnel about environmental requirements and reporting compliance status to the contractors, AOGP, the FERC, and other agencies, as required.

AOGP will develop and implement an environmental training program during construction of the Project to ensure all construction personnel are aware of environmental permit requirements. The program will be designed to ensure that construction personnel receive environmental training appropriate to their task before they begin work, adequate training records are kept, and refresher training is provided as needed. For all construction activities offshore, all personnel will receive special Marine Mammal Observation and Awareness training prior to going to the work site offshore. In addition to the project EIs, specific National Oceanic and Atmospheric Administration (NOAA) certified Marine Mammal Observers (MMOs) will be on each construction vessel for the duration of construction and clean-up activities.

1.6.2.1 Temporary Support Facilities

It is anticipated that the construction office and onshore contractor staging areas will be located on industrial land within the Aguirre Plant property. AOGP anticipates utilizing an existing deep water access construction dock, also within the power station property, with direct access to the Jobos Bay barge channel.

Following is a description of general construction procedures for each major Project component.

1.6.2.2 Offshore Berthing Platform

AOGP will pursue the use of prefabricated modular designs, made up of precast elements fabricated under plant conditions rather than on site. Use of precast elements reduces the need for onsite complex formwork operations over water. Advantages include a reduced construction schedule and smaller crews and associated marine support. Minimized labor time on-site in the marine environment reduces overall safety hazards and risk, as well as reduces the duration of temporary environmental impacts.

The Offshore GasPort will consist of tubular steel structures to support the deck and topsides equipment (known as jackets), pile structures, steel deck, and topsides equipment. The jackets, piles, and steel deck will be prefabricated before arriving on site. Installation will be accomplished using a variety of marine vessels, including material transport barges, crane barge, crew/supply vessels, dive support vessel, and vessel support tugs.

Marine Infrastructure

The proposed project includes 13 structures to be placed into the seabed, including 9 structural jackets and 4 tri/quad pile structures. Jackets will be used for the utilities platform and berthing dolphins while the tri/quad piles will be used for the smaller mooring dolphins which are exposed to lesser loads. Prior to installation AOGP will require the construction contractor to develop an installation plan that will identify parameters for accuracy of placement of structures, including positioning and leveling. Installation of the marine structures will be accomplished using a barge-mounted crane which will lift the structures from a transport barge and lower into the water.

Jackets will be set down on mud mats on the seafloor prior to driving of the main piles. Main piles will be driven through the hollow jacket sleeves into the seafloor using vibratory pile drivers or diesel pile hammers. The tri/quad piles will also be installed using vibratory or impact pile hammers.

Once the marine structures are installed superstructure installation will commence which will consist of lifting deck sections, module support frames, and module packages from the transport barges onto the jackets and pile structures. Modules will then be connected to the jackets or pile structures and each other as specified by the design. On-site installation of the marine infrastructure will take approximately 9 months.

Topsides

Topsides equipment will be on prefabricated skid packages. Skid packages will be lifted into place with a barge crane, secured to the deck, and all connections completed. Once connected the topsides equipment will be tested. Installation and testing of the topsides equipment will take approximately 8 months.

1.6.2.3 FSRU

AOGP will use an already built FSRU for the proposed Project; therefore, no new construction is required for the FSRU component of the Project.

1.6.2.4 Subsea Interconnecting Pipeline

Installation

AOGP proposes to install the interconnecting pipeline on the seabed using a "push pipe lay" technique. This installation method will result in the pipeline being laid directly on the sea floor, unburied or only partially buried by natural bottom sediments depending on the sediment type. AOGP is proposing this installation method because a direct lay results in substantially less area of sea floor impact and substantially less sediment disturbance and associated water quality impact during construction than other installation methods. This will involve the use of a crane barge, pipe lay barge, temporary piles and winches to pull from the point of insertion to the end of each tangent. The pipeline will be concrete coated for protection, to provide negative buoyancy and for pipeline stability and safety. AOGP does not intend to install additional cover or mats ontop of the subsea interconnecting pipeline. The use of additional cover or mats may be considered during detailed pipeline design.

The subsea pipeline will be installed in five segments, with segment end points defined by points of inflection (PI) along the pipeline. Each segment will be fabricated on shallow water pipe lay barges that will be secured to the bottom with temporary piles and will not use dynamic positioning or anchors.

Temporary piles will also be used to anchor pulleys that will be used for pushing/pulling pipe segments into place using cable and winch mounted on the lay barge. Except for two segments the pipeline will be pushed/pulled into place along the bottom, with no trenching. The proposed pipeline installation method will have minimal effect on the bathymetric contours of the seabed, leaving only a portion of concrete coated pipeline exposed and a small mounding of sediment on either side of the pipeline that is pushed aside as the pipeline is laid into place. Installation by pipeline segment is described below. Work space required for subsea pipeline construction, including tie-in to the existing Plant facilities and staging areas, is shown on Figure 1-8.

Shore Approach and Tie-In, PI#6 – PI#5 (Approximate MPs 4.1 – 4.0)

For this segment a crane barge will be positioned along the Aguirre Plant bulkhead just south of the pipeline landfall (MP 4.1). The pipeline segment will be fabricated with the necessary bends on the crane barge and set in place with the crane. The shore approach will include a vertical section (riser) that will be attached to the bulkhead wall, with rise clamps with an above-ground horizontal section on the landward side fixed to a concrete support. Fabrication and installation of the shore approach segment will take approximately 21 working days.

PI#5 – PI#4 (Approximate MPs 4.0 – 3.0)

For this segment the pipe lay barge will be positioned within the construction right-of-way just east of PI#4 (MP 3.0), and a temporary pile placed at PI#5 (MP 4.0) to anchor a pulley used to winch the pipe segment off the barge. The pipeline segment will be fabricated on the lay barge at PI#4 and pulled with a cable to PI#5 where it will be tied into the shore approach segment. Installation of this segment will take approximately 14 working days.

PI#4 – PI#3 (Approximate MPs 3.0 – 1.6)

For this segment the pipe lay barge will be positioned within the construction right-of-way just north of PI#4 (MP 3.0), and a temporary pile placed at PI#3 (MP 1.6) to anchor a pulley used to winch the pipe segment off the barge. The pipeline segment will be fabricated on the lay barge at PI#4 and pulled with a cable to PI#3. Installation of this segment will take approximately 20 working days.

PI#3 – PI#2 (Approximate MPs 1.6 -1.0)

Installation of this segment will utilize the same pipe lay barge and temporary pile locations as the previous segment, with the barge remaining at PI#4 (MP 3.0) and anchor pile at PI#3 (MP 1.6), plus an additional temporary anchor pile at PI#2 (MP 1.0). The pipe segment will be fabricated on the barge, temporary floats installed, and pushed/pulled toward PI#3. When the proper length is fabricated, tugs will be attached to each end of the pipe string and it will be towed into place. Once in place it will be tethered to the anchor piles at PI#3 and PI#2, and flooded to drop into place on the seafloor. Installation of this segment will take approximately 21 working days.

PI#1 – Offshore Platform (Approximate MPs 1.0 - 0.0)

For this segment the pipe lay barge will be repositioned just west of the offshore platform site (MP 0.0). The temporary anchor pile previously used at PI#2 (MP 1.0) will also be used for this segment. The pipe segment will be fabricated on the barge and the string pushed/pulled to PI#1. Installation of this segment will take approximately 14 working days.

Tie-in and Anchoring

After all pipeline segments are in position they will be tied into the adjacent segments. The pipeline segment installed through the Boca del Inferno (PI#3 – PI#2) will be anchored at each end of the segment using augers placed into the seafloor. During installation of the offshore berthing platform a pipeline riser will be installed on a support structure to make the connection between the topside facilities and the subsea pipeline. The subsea pipeline will be tied into the riser at MP 0.0. Tie-in and anchoring will take approximately 30 working days.

Hydrostatic Testing

The pipeline will be hydrostatically tested (hydrotest) upon completion of the lay but prior to final tie in to the Offshore GasPort and Aguirre Plant. AOGP will obtain all required permits and authorizations to conduct the hydrostatic tests. Prior to hydrotesting, the pipeline will be gauged to verify its geometric integrity by running a gauging plate inside the pipeline.

Detailed hydrostatic testing procedures will be developed during detailed pipeline design; however general procedures will be as follows. The subsea pipeline will be pigged following construction. The hydrostatic test medium will be seawater, and the filter screen size for water intake will be 100 micron. The intake rate for the pig runs will be dependent upon the speed of the pig, which will be somewhere between 1.5 to 3 feet per second (fps) for a total of approximately 10.7 hours to 16.1 hours. The hydrostatic test water will not be treated when it is injected. Based on volume of the pipeline, about 240,000 gallons will be required to fill and test the pipeline, however the actual amount of water needed to complete the testing will depend on the number of hydrostatic tests required. Assuming one to three tests may be required to complete hydrostatic testing, testing will require between 240,000 and 720,000 gallons of water. The pipeline will be dried upon completion of the hydrostatic test. All federal and state rules, regulations, and permits related to the pipeline design, engineering, construction, installation, and commissioning will be taken into consideration during the continued design development of the project.

Hydrostatic testing and final tie-in to the offshore platform and the Aguirre Plant will take approximately 10 days. The duration of a successful hydrostatic test will be 8 hours.

Construction and Support Vessels

Pipeline construction will involve various vessels with specialized construction capabilities, as well as vessels to support construction activities. Typical pipeline construction and support vessels are described below.

- Shallow Water Lay Barge: The lay barge constructs the pipeline through a series of functions that produce a welded, inspected, and concrete coated pipeline on the seabed. This vessel utilizes a variety of winches, cranes, and specialized equipment to perform its function. The lay barge will be anchored to the bottom with temporary piles placed directly alongside the barge such that bottom impacts will be limited to the area directly along the pipeline route. Use of the shallow water lay barge with temporary piles, rather than anchors and cables, will avoid a large area of bottom impact that typically results from anchor placement, replacement, and cable sweep that would result from use of anchors and cables. Any bottom impact from lay barges will be contained within the construction right-of-way. It is expected that a single lay barge will be used, repositioned along the pipeline route as needed.

- Dive Support Vessel: The dive vessel performs diving-related activities such as tie-ins, hydrotesting, and other dive-related functions. This vessel utilizes winches, air compressors, pumps, lift devices, and hydraulic power units to perform its function. The dive support vessel would typically be a spud barge temporarily positioned within the construction right-of-way. It is expected that a single dive support vessel will be used, repositioned along the pipeline route as needed.
- Assist Tugs: Assist tugs will be used to spot the Lay barge, other floating equipment, and to float one pipeline segment into place. It is expected that one or two assist tugs will be used during pipeline construction depending on the level of activity and pipeline segment being installed.
- Crew/Supply Boat: This vessel is used to shuttle personnel and supplies from the landside dock to the lay barge and dive support vessel. It is expected that one crew/supply boat will be used during pipeline construction as needed to support the lay barge and dive support vessel.
- Pipe Transport Barge: This barge is loaded with pipeline segments at the pipe coater's yard and transports the pipe to the lay barge. It is expected that a single pipe transport barge will be used during pipeline construction.
- Pipehaul Barge Tug: This tug boat shuttles the pipe transport barges between the pipe yard and the lay barge. It is expected that a single pipehaul barge tug will be used during pipeline construction.

All personnel manning each of these vessels will receive specific marine mammal observation training prior to being allowed to work offshore. NOAA-approved marine mammal observers will be utilized during the entire construction phase.

1.6.3 Restoration Procedures

AOGP has conducted bathymetric, geophysical and benthic surveys of all areas potentially affected by construction of the offshore berthing platform and subsea pipeline, including all structure locations and construction barge locations. Benthic surveys have identified sensitive bottom habitats, and results will be used to micro-site the Project components as well as construction barge and support vessel placement areas to avoid or minimize to the extent possible impacts on sensitive bottom habitats. For any areas where avoidance is not possible and a sensitive habitat is affected during construction, AOGP will consult with appropriate agencies to determine the need for a restoration plan, and will develop plan(s) and implement following construction as necessary. Restoration plans will be developed in consultation with the Jobos Bay National Estuarine Research Reserve (JBNERR) and other resource agencies as appropriate. Additional information is provided in Resource Report 3.

1.7 OPERATION AND MAINTENANCE PROCEDURES

The Project will be operated and maintained by appropriately-trained and licensed employees and contracted entities, in accordance with applicable statutes and regulations, regulatory permit conditions and authorizations, engineering design specifications, recommended manufacturer maintenance practices, and Project operating policies and procedures. Operation of the Project will be supported from a land-based office facility located in the Project area, with access to a marina facility to provide access to support vessels. The estimated number of permanent Project operation and maintenance staff required is provided in Resource Report 5.

Excelerate Energy maintains procedures for the operation and maintenance of its existing facilities and AOGP will do the same for the proposed Project. These procedures are designed to assure the effective conduct of operations as well as to assure reliability and availability of its assets. These documented procedures are proprietary and confidential in nature largely due to the unique nature of its import facilities.

1.7.1 Commissioning

Following completion of construction, but prior to the start of standard operation, the Offshore GasPort must be commissioned. The commissioning process will focus on key activities pertinent to commissioning of the Offshore GasPort. This process will provide necessary time to successfully complete all pre-commissioning activities, commissioning, and completion works to be performed at the Offshore GasPort incorporating all requirements of vendors, regulatory agencies, and port operations.

All regasification equipment on board the FSRU has already been commissioned but will be run through full performance capability as defined by vendor specifications to ensure minimum and maximum rates are established for the Offshore GasPort.

Equipment in the commissioning process will include:

Offshore Berthing Platform and Associated Equipment

- High pressure marine loading arm (HPMLA);
- Ship shore link (SSL) - fiber optic and electrical;
- Distributed control system (DCS);
- Quick Release Mooring Hooks with Tension Monitoring System
- Berthing Assistance System
- Emergency shutdown (ESD) valves and ESD system;
- Fire fighting and gas detection equipment;
- Security and site monitoring equipment;
- Gas meter(s) and gas chromatograph;
- Communications equipment; and
- Berth monitoring system (BMS) and mooring system.

FSRU Equipment

- Regasification system and associated equipment;
- Emergency shutdown valves and ESD system;
- Gas meters and gas chromatographs; and
- Communications equipment.

1.7.1.1 Pre-Commissioning Meeting

A pre-commissioning meeting will be conducted prior to the FSRU berthing and the start of commissioning activities. The meeting will be chaired by the Commissioning Manager. The FSRU's Master, key FSRU officers, Person in Charge, pertinent technicians, and vendor representatives shall be in attendance. The meeting will include a discussion of the schedule of planned activities, safety considerations and requirements, communications, and responsibility and authority of persons involved.

1.7.1.2 Commissioning Activities

Commissioning will consist of the following activities:

Onshore Receiving Facility

Commissioning procedures will be written in coordination with PREPA's Aguirre Plant Operations team.

Topsides

The bulk of activity for the topsides commissioning will be focused on verifying marine infrastructure, ship and shore side operation, and functionality of the mechanics and automation control, including;

- Ship to Shore Link (SSL);
- Mooring Systems;
- Firewater;
- High Pressure Loading Arm(s);
- Liquid transfer arm(s);
- Shore side high pressure gas system;
- Supervisory Control and Data Acquisition (SCADA) distributed control system;
- Emergency Shutdown Valves (ESD);
- Emergency Release Couplings (ERC); and
- Utility support systems.

Subsea Pipeline (HP Gas Line N2 displacement, hydrocarbon fill and pressurization)

- All ESDVs, SDVs, SXNV's and FCVs shall have been opened prior;
- The low pressure nitrogen in the pipeline shall be vented to atmosphere using the vent points at the plant end;
- The pipeline shall be filled with hydrocarbon gas;
- Gas meters shall be used to verify that all nitrogen has been purged from the system; and
- Gas flow shall be increased in pre-determined controlled stages until commissioning pressure and flow rate is achieved.

LNG Transfer and Regasification Facility

- The LNGC berthing / mooring and marine interfaces shall be completed in accordance with the approved maneuvering plan and mooring arrangement;
- The FSRU berthing and mooring shall be completed in accordance with the approved maneuvering plan and mooring arrangement;
- Connect and test the ESD and communications SSL;
- Connect the LNG / GNG cargo transfer arms;
- Connect the HP gas arm(s) on the FSRU;
- Prepare for ESD test;
- Open ESDVs & SDVs;
- Conduct ESD Test;

- All emergency shutdown and safety systems associated with gas output have been tested and proven;
- Cool down LNG transfer system in preparation for the LNG transfer;
- Commence LNG transfer from LNGC to FSRU as per procedure;
- Upon appropriate inventory of LNG on board the FSRU, commence cool down of regasification equipment;
- Line up NG system as per commissioning plan;
- Upon completion of the LNG transfer, de-inventory the liquid transfer system per procedure; and
- Upon completion of regasification equipment cool down and LNG transfer, commence FSRU Regasification start-up as per procedure, including:
    - Start SHP at minimum flow and maximum temp. The downstream gas pipeline will be pressurized from the regasification vessel;
    - Upon completion of pressurization , initiate HPP start and discharge at commissioning flows & temperature;
    - All line parameters to be monitored. Gas metering functions to be checked. Comparison made between fiscal meter and FSRU send-out metering; note any discrepancy;
    - Commissioning deemed complete;
    - Shut down regasification system to inspect HPLA; and
    - Restart regasification operations and commence commercial operations.

1.7.1.3 Post-Commissioning Meeting

A post-commissioning meeting will be conducted after completion of commissioning activities to discuss issues encountered, lessons learned, and required follow-up on same.

Following completion of Project commissioning, standard operation and maintenance procedures will begin as described below.

1.7.2 Offshore Berthing Platform

There are two primary functions of the offshore berthing platform during operation: 1) receipt and transfer of LNG from a LNGC to the FSRU; and 2) receipt of regasified LNG from the FSRU and transfer into the sendout pipeline.

1.7.2.1 Receipt and Transfer of LNG

LNG is transferred from a LNGC via platform pipework to the FSRU. Specific components to accomplish this include:

- Four LNG liquid loading arms and two LNG vapor arms, including associated emergency disconnect equipment;
- ANSI Class 150 stainless steel pipe work, ESD valves, motorized isolation valves and pressure and temperature transmitters which interface the DCS and the Safety Instrumented System (SIS);
- FSRU SSL;
- LNGC communications link;
- Utility systems including Instrument air and nitrogen;
- Process support systems;

- Electrical systems; and
- Safety systems.

Liquid and Vapor Loading Arms

The design of the liquid and vapor loading arms are identical. All six (6) loading arms are sized and rated 16-inch ANSI Class 150 and suitable for cryogenic service. The loading arms have been designed to the Oil Companies International Marine Forum (OCIMF) Design and Construction Specification for Marine Loading Arms (Third Edition - 1999).

LNG Transfer Activities

Specific activities involved in the transfer process include:

- Cool down of LNG liquid loading arms and LNG liquid pipe work;
- Unloading LNG liquid from the LNGC;
- Dock side transfer of LNG liquid and LNG vapor;
- Loading LNG into the FSRU;
- Draining LNG liquid loading arms at the end of an LNG transfer; and
- Recapture of residual LNG in the dockside pipework at the end of an LNG transfer or following the cessation of operations.

1.7.2.2 Receipt and Transfer of Regasified LNG

During operation the FSRU will convey the natural gas to the sendout pipeline. Specific components to accomplish this include:

- High pressure gas loading arms and associated emergency disconnect equipment;
- Class 900 low temperature carbon steel pipe work, incorporating non return valves, ESD valves, motorized isolation valves and pressure and temperature transmitters which interface the DCS and the SIS, and a pig launcher;
- FSRU SSL;
- Utility systems including gas/diesel fueled electricity generators, nitrogen generators, electric sea water pumps, diesel fire pumps, diesel storage tanks, lubrication oil storage tanks, potable water and waste water tanks, sewage treatment unit, and fire water monitors;
- Process support systems;
- Electrical systems; and
- Safety systems.

High Pressure Gas Loading Arm

High Pressure Gas Loading Arms (Figure 1-12) are mounted on a steel tower located on the offshore berthing platform. The loading arm is used to convey high pressure regasified LNG from the delivery flange on the FSRU high pressure manifold to the platform. Incorporated in the arm are a quick connect/emergency disconnect system and an inlet ESD valve and an emergency disconnect ESD vent valve.

The twelve (12) NPS ANSI Class 900 loading arm has been designed by Emco Wheaton to the OCIMF Design and Construction Specification for Marine Loading Arms (Third Edition - 1999). The specification covers the minimum requirements for marine loading arms and their ancillary equipment for loading and/or unloading ships and barges at conventional marine terminals and Sea Islands. The design of the arms will accommodate the range of movements that are expected when the arms are connected to the FSRU under high and low water conditions and in the loaded cargo and ballasted states.

The High Pressure Gas Loading Arms will be in the stowed position on the platform without internal pressure when not in use. The motive power to enable the operator to move, connect or disconnect the loading arms is provided by a hydraulic power system.

Connection of the High Pressure Gas Loading Arms to the FSRU is made by a quick connect/quick disconnect and emergency release system (QC/DC-ERS). The QC/DC-ERS also provides a means of disconnecting the arm in an emergency in the event of the vessel/arm moving outside of the specified operating parameters. Additionally it allows a manually initiated emergency disconnection.

When connected to the FSRU the operating envelope of the arm is monitored by potentiometers and the arm position can be viewed and tracked via a monitoring system located in the control room on the platform. The arm position can also be monitored from the FSRU via a communications link. Independent proximity switches are used to monitor the position of the arm against predefined operating limits and these will initiate sequential safety actions in the event that the position of the arm exceeds the operating limits.

Utility Systems

On-site nitrogen will be required to purge and inert the facility to prepare for maintenance or startup after a lengthy shutdown. A nitrogen generator sufficient to sustain the normal operations of the Offshore GasPort will be included on the platform.

Electic power for the offshore berthing platform will be generated and supplied by gas/diesel fueled generators located on the platform . The platform will also include switchgear, transformers, and motor control centers as needed to distribute power throughout the facility. The electrical equipment will be housed in a climate controlled switch room.

1.7.2.3 Safety Systems for the Offshore Berthing Platform

A fire and gas detection system will be provided that will alert personnel to a fire or gas incident and to minimize the risk to personnel and facilities by early detection. This will be achieved by the automatic detection of fire and gas conditions, which will result in the automatic initiation of alarms, thereby warning operator and site personnel of emergency conditions and enabling the site emergency contingency plans to be put into operations.

The offshore berthing platform will also include an ESD System that will be an electronic system with sufficient redundancy to ensure system reliability in the event of a safety related upset. Field valves will be fail-safe. This system will also be hard wired to the FSRU ESD systems.

Fire water will be provided by two (2) diesel driven fire pumps. The offshore berthing platform will include a firewater distribution system that will supply water to fire stations, fire water monitors, and fire water curtains. The firewater system will be designed to use seawater. Two (2) electrically driven sea water pumps will be provided for deck washing during LNG transfer.

1.7.3 FSRU

With the exception of one vessel in the fleet which can only operate in closed-loop regasification mode, each of Excelerate Energy's existing FSRUs is capable of three modes of LNG vaporization designed as closed-loop, open-loop, and combined mode. The FSRU assigned for the proposed Project will utilize the closed-loop vaporization mode. In the closed-loop mode, steam from the FSRU propulsion steam boilers is used to heat fresh water circulated through the shell-and-tube vaporizers to regasify the LNG. There is no seawater intake or discharge used specifically for the regasification process in the closed-loop mode. Operation of the FSRU during the regasification process is described below.

1.7.3.1 LNG Regasification Process

The regasification system comprises a suction drum, high-pressure pumps, high pressure vaporizers, metering system, and low and high pressure pipe work and valves (see Figure 1-13). LNG is stored in the cargo tanks at a pressure slightly above atmospheric and is pumped by low pressure (LP) feed pumps to the suction drum which serves as an accumulator and surge vessel for the high pressure (HP) LNG pumps.

From the suction drum, the liquid pressure to the vaporizers is increased by the HP pumps. The regasification system includes two small HP pumps. The small HP pumps, each with a capacity of approximately 10 MMscf/d (11,800 sm^3/h), are used for pressurization of the system during start up. These pumps increase the system pressure gradually during start up without excessive generation of boil off gas. Once a regasification flow rate of 10 MMscf/d (11,800sm^3/h) has been achieved, the LNG vaporizer outlet control valves are set to control the vaporization process at a pressure of not less than 75 barg.

A single HP pump is utilized to increase the LNG flow rate to the minimum operating flow rate of 50 MMscf/d (59,000sm^3/h). The flow rate can then be increased up to 100 MMscf/d (118,000 sm^3/h) with a single pump. Flow rates up to the contractual flow rate can be met by progressively starting additional vaporizer and HP pump streams. The HP pump raises the pressure of the LNG to match the export pipeline pressure (75 to 100 barg) and sends the cold LNG to the LNG Vaporizer. There are six 100 MMscf/d (118,000 sm^3/h) capacity HP pumps on an Excelerate Energy FSRU. Five pumps are utilized to deliver gas at a sustained rate of up to 500 MMscf/d (590,000sm3/h). Therefore, there will be sufficient spare capacity on the FSRU to ensure high availability and reliability of the terminal. The sixth pump is used for peak capacity operation.

The FSRUs incorporate six LNG vaporizers. The vaporizer is a shell-and-tube heat exchanger where the LNG is vaporized to natural gas and heated to approximately 4°C (39°F) minimum by the vessel's internal heating system (closed-loop mode). The normal natural gas flow rate through the vaporizer is between 50 and 100 MMscf/d (59,000 and 118,000 sm^3/h), with a maximum peak flow rate of 115 MMscf/d (135,430 sm^3/h). The temperature and pressure are measured at each vaporizer outlet line in order to calculate the re-gas flow rate using the recorded actual pressure drop at a flow measuring orifice. The signal is then sent to each vaporizer flow controller.

On leaving the LNG Vaporizer, natural gas flows through a metering station, and then through a Pressure Regulating Station that maintains a minimum pressure of approximately 75 barg in the regasification system, and then into the export pipeline. The natural gas then passes through the delivery flange on the high pressure manifold and into the high pressure natural gas loading arm on the offshore berthing platform.

1.7.3.2 Operation and Control of the Regasification System

The regasification and gas delivery operation is continuously manned and is controlled utilizing the FSRU's Integrated Automation System (IAS). The high pressure gas system is protected by means of high pressure trips, low temperature trips, and relief valves. The FSRU ESD system will activate to shut down the regasification process in the event that a ship or shore side ESD condition is present. The FSRU's IAS ensures the safe operation of the re-gasification plant within the system design parameters.

For each re-gasification nomination the FSRU operator will utilize a configuration screen to input three ordered parameters:

- Required discharge rate;
- Maximum discharge pressure; and
- Minimum discharge temperature

The Offshore GasPort design will provide for the following Operating Modes:

- Inerting;
- Warm Startup;
- Cold Startup;
- Startup from ambient temperature with air atmosphere within system;
- Steady-state Operation;
- Operation at minimum send out (turndown);
- Normal shutdown and Warm-up;
- Emergency Shutdown; and
- Depressurizing.

1.7.3.3 FSRU Maintenance

The FSRU will be at the north (landward) side of the offshore berthing platform year-round performing regasification services. However, in order to maintain vessel class certificates and ensure commercial reliability, periodic maintenance outages are scheduled for preventative maintenance and repairs on the main boilers, auxiliaries and associated regasification system. Additionally scheduled dry-docking (typically every 5 years) may be performed as per class requirements. If required, normal dry-dock time is approximately 21 days, excluding transit time to and from respective dry-dock port. During scheduled dry-dock periods, PREPA may require AOGP to use reasonable efforts to provide a similar FSRU, capable of meeting applicable permit parameters and contractual send-out rates to act as an FSRU in the supply of natural gas.

1.7.3.4 FSRU Water Use

The FSRU for the proposed Project will utilize the closed-loop vaporization mode during LNG vaporization which will not require direct seawater intake or discharge for LNG vaporization. However, other standard vessel operations will require seawater use, whether the FSRU is in standby mode or vaporization mode. FSRU water use for each component is described below. Seawater for all onboard use is withdrawn through the FSRU's sea chests.

While no seawater intake or discharge is used for the regasification process, the normal water use requirements of an FSRU is up to approximately 56 million gallons per day (MGD) at an intake rate of approximately 0.45 fps. Of this volume, up to approximately 54 million gallons are used to support machinery cooling and the operation of the vessel's safety water curtain and then discharged. The remaining volume, up to approximately 2 MGD, is retained as ballast water and water to support crew needs (e.g., sanitary needs and potable water). The exact amount of ballast water needed for the FSRU on a daily basis will vary to compensate for the change in draft of the vessel as natural gas is sent out and LNG is transferred onboard, but cannot exceed the amounts detailed in Table 1-3 as these are the maximum water intake rates of the intake pumps when operating in the closed-loop regasification mode. Table 1-3 summarizes standard intake and discharge requirements.

Table 1-3
Summary of Standard FSRU Water Use Intakes and Discharges[1]

FSRU Component	Maximum Intake Pump Capacity (cubic meters per hour [m^3/hr])	FSRU Seawater Intake (MGD)	FSRU Seawater Discharge (MGD)
Main Condenser Cooling System	7,400	47.0	47.0
Auxiliary Seawater Cooling System	935	6.0	6.0
Safety Water Curtain	90	0.6	0.6
Ballast Water	295	1.9	±1.9[2]
Freshwater Generator	48	0.3	0.27
Marine Growth Preventative System	-	0.16	0.16
	Total	**55.96**	**55.93**

[1] *Based on continuous operation of an Excelerate Energy FSRU.*
[2] *Discharge based upon loading rate and buoyancy compensation needs for the FSRU.*

The FSRU draws all water through four, interconnected sea chests designated as starboard high, starboard low, port high and port low. For filtration, each sea chest has metal grates with 21 millimeters (0.83 inch) slots between the grate bars (Table 1-4 describes typical FSRU sea chest dimensions). The high sea chests are located approximately 23 feet below the surface of the water while the low sea chests are located approximately 38 feet below the surface of the water.

Table 1-4
Summary of Typical Sea Chest Dimensions

Sea Chest	Grids	Open Area per Grid (Square Feet)	Total Open Area (Square Feet)
Starboard High	4	8.2	32.8
Starboard Low	6	6.9	41.4
Port High	8	8.2	65.6
Port Low	8	6.9	55.2
		Total	**195.0**

1.7.4 Subsea Pipeline

The subsea pipeline will be operated and maintained by AOGP in accordance with 49 CFR Part 192 and other applicable regulations. The pipeline will be inspected for leakage as part of scheduled operation and maintenance.

1.7.5 LNG Carriers

Operation of the Project will require regular deliveries of LNG supplied from LNGCs loaded at various LNG liquefaction facilities worldwide. Providing natural gas to the Aguirre Plant at maximum throughput rate will require approximately 50 LNGC deliveries per year (approximately one every 8 days).

Because the Aguirre Offshore GasPort will be located approximately 3 miles offshore, no defined waterway will be used by LNGCs en route or departing from the Project. The Project will not require a defined approach channel delineated with a conventional navigation demarcation system. Furthermore, there are no shoreline areas adjacent to the approach. However, there will be a defined approach maneuver for vessels calling at the facility, which will include the use of escort vessels, licensed maritime pilots, and tug support vessels of adequate size.

While unloading LNG cargo at the Offshore GasPort, LNGCs will take in seawater as ballast to maintain a constant draft. Ballast water is taken onto the vessel through its sea chests while offloading cargo which is estimated to take up to 72 hours to complete. Ballast water is typically only discharged during loading operations at an LNG export terminal or during mid-ocean ballast water exchanges during the transit. Therefore, no ballast water would be discharged from LNGCs while at the offshore berthing platform. It is expected that all LNGCs calling on the Project will comply with International Maritime Organization standards for ballast water exchange as well as current USCG requirements.

LNGCs unloading at the Offshore GasPort will also need cooling water for the engines that generate electrical power for the offloading pumps and other onboard systems. The USCG requires that ships' engines are powered up while at dock; therefore, there would be cooling water needs during the entire time each LNGC is at the offshore berthing platform (estimated to be up to approximately 88 hours).

Estimates for vessel water consumption are derived from three sources; the Jordan Cove FEIS (FERC 2009), the Broadwater LNG FEIS (FERC 2008), and information provided by Oregon LNG in its application to the FERC (CH2MHill 2008). The Jordan Cove FEIS estimated a range of cooling water intakes, with a low of 1,250 m^3/hr based on diesel engine vessels using some shore power. Oregon LNG (CH2MHill 2008) estimated about 6,300 m^3/hr for cooling water use, while the Broadwater EIS (FERC 2008) used the highest value of about 9,800 m^3/hr. The range of potential cooling water and ballast water requirements are shown in Table 1-5. Based on the current vessel characteristics available in the fleet, the higher estimate of water use is most likely to be representative of this Project.

Table 1-5
Estimates of LNG Carrier Water Use and Rate While at the Aguirre Offshore Gas Port

Range	Time to Offload (hr)	Total time at AOGP (hr)	Ballast Intake Rate (M^3/hr) [1, 2]	Ballast Volume (million gallons)	Cooling Intake Rate (M^3/hr)	Cooling Volume (million gallons)	Total Intake Volume (million gallons)
Low	25	41	2,600	17.2	1,250	13.5	30.7
High	72	88	3,900	74.2	9,800	227.8	302.0

[1] *All ballast intake occurs during offloading.*
[2] *Low value from FERC 2009, high value from FERC 2008.*
1 m^3 = 264.17 gallons.

These LNGCs would take in about 17.2 to 74.2 million gallons of water for ballast while offloading at the Offshore GasPort. Total cooling water volume would range from about 13.5 to 227.8 million gallons while stationed at the Offshore GasPort. Therefore, the total water intake for each LNGC delivery (ballast and cooling water) could range from about 30.7 to 302.0 million gallons. Additional discussion of seawater use by LNGCs is included in Resource Reports 2 and 3.

1.8 SAFETY AND SECURITY

In terms of the Quality and Environmental Management Systems applicable for regasification vessel operations, Excelerate Energy's existing regasification vessels are operated in partnership with Exmar Shipmanagement. Exmar Shipmanagement's Quality Management System has been certified by Det Norske Veritas (DNV) as conforming to ISO 9001 standards, and currently implements an Environmental Management System to ISO 14000 standards. This system was recertified for ISO 14000 in December 2010. Additionally, Exmar Shipmanagement's Safety Management System has been certified by DNV as complying with the requirements of the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM code).

The Offshore GasPort design will consider all required and reasonably-foreseeable aspects that may affect security and safety of operation, including preventative and responsive actions to events that may affect vessel approach to and berthing at the facility, and routine operations.

The development of the Aguirre Offshore GasPort could pose potential hazards impacting both port function and public safety. Principal concerns involve events or incidents that could lead to either an accidental or intentional LNG spill. Identified consequences resulting from a LNG release or spill include cryogenic structural damage and burns, asphyxiation, overpressure, mechanical damage, and thermal radiation due to fire. The Aguirre Offshore GasPort will be located approximately 3 miles offshore from the Aguirre Plant in deep water with minimum depths of approximately 60 feet. Based on the location of the proposed site minimal impacts are anticipated to shore-based infrastructure and the local population in the event of an LNG related incident.

Accidents or incidents that may pose potential risk of an unintentional LNG release or spill for further consideration include:

- A vessel colliding with a LNGC or FSRU in transit to and from the offshore berthing platform;
- A LNGC or FSRU allision with the offshore berthing platform; and
- A LNGC or FSRU grounding severe enough to penetrate the cargo containment system.

The Project will undergo a Facility Security Assessment (FSA) which will be used to develop a Port Facility Security Plan (PFSP) in accordance with the International Ship and Port Security Code. The analysis for the Aguirre Offshore GasPort Waterway Suitability Assessment (WSA) will provide a starting basis for the FSA and PFSP and will include safety and security issues for both in-transit and moored LNG vessel operations leading to the potential of an accidental or intentional release of LNG. To establish risk relative to an accidental or intentional LNG release, the WSA will evaluate the effectiveness of safety measures and security countermeasures proposed or currently being used at other operations by AOGP.

The WSA will involve the development of a GAP analysis to identify what resources (public and private) are currently being employed to ensure safe and secure operations at other facilities in the region, and what resources (public and private) will need to be identified and engaged to provide support to ensure safe and secure operations once the Aguirre Offshore GasPort becomes operational.

The need for the establishment of security and safety zones around the Aguirre Offshore GasPort during operation will be determined during preparation and review of the WSA in consultation with the USCG. All factors potentially detrimental to safety, including vessel congestion, presence of harmful or hazardous substances, and the presence of obstructions around the proposed project location, will be considered. If it is determined that a safety zone and area to be avoided is appropriate AOGP will present the zone to the International Marine Organization for approval. The safety zone and area to be avoided will be published in Federal Register and public notice will be provided via broadcast notices to mariners, local notices, or other means.

1.9 FUTURE PLANS AND ABANDONMENT

AOGP presently has no plans for expansion of the Aguirre Offshore GasPort. The Project is designed to meet the requested volume of its single customer, PREPA, for the planned conversion to natural gas of all units at the Aguirre Plant. AOGP notes, however, that a recent report by Puerto Rico's Intersectoral Committee on Environmental Compliance and Energy Alternatives (ICECEA) identified the Aguirre Offshore GasPort as one of the potential future options for supplying the natural gas necessary to convert PREPA's other power plants by means of the redelivery of LNG from the FSRU to PREPA's facilities. To the extent that expansion or modification of the Aguirre Offshore GasPort becomes warranted in response to additional requests from PREPA, any expansion, modification or additional use of the Offshore GasPort will be designed to be compatible with the proposed facilities, and AOGP will obtain all necessary permits and approvals for those facilities or additional uses.

AOGP has no current plans for abandonment of the Aguirre Offshore GasPort. In the event the decision is made to abandon the Aguirre Offshore GasPort, AOGP will work with FERC and other appropriate agencies to properly abandon the facility either in place or by removal.

1.10 PERMITS AND APPROVALS

AOGP will apply for all necessary permits, clearances, and licenses relating to the construction and operation of the Aguirre Offshore GasPort. Table 1-6 provides a list of major permits and approvals that AOGP must obtain for the Project. AOGP has begun consultation with the agencies for each respective permit or approval. AOGP will file with FERC copies of agency responses to information requests, and approvals and clearances, upon receipt.

1.11 AFFECTED LANDOWNERS

The Aguirre Offshore GasPort Project will affect the Commonwealth of Puerto Rico as the single landowner. The onshore portion of the send out pipeline and associated onshore facilities required to interconnect the pipeline with the Aguirre Plant will be on the power station property, owned and operated by PREPA. AOGP has had numerous discussions with PREPA regarding the Project, which is in accordance with 18 CFR 157.21(f)(3) and 18 CFR §157.6(d)(2).

The offshore components of the Project will impact territorial waters and submerged lands and will be regulated by the DNER according to the Regulation for the Use, Vigilance, Conservation and Administration of the Territorial Waters, Submerged Lands and the Maritime Zone. The regulations do not prohibit a project such as the proposed Aguirre Offshore GasPort Project; however, they establish a mechanism for review of environmental impact and public interest and benefits. To initiate review under these regulations AOGP will submit to the Secretary of the DNER an application for Coastal Zone Use Authorization or Concession.

Table 1-6
Permits, Reviews, and Consultations for the Aguirre Offshore GasPort Project

Agency	Permit/Approval/Consultation	Statutory Basis/ Regulations	Actual/ Anticipated Submittal	Anticipated Receipt
Federal				
Federal Energy Regulatory Commission (FERC)	Authorization to Site, Construct and Operate, Facilities Used For The Import of Natural Gas	Natural Gas Act, Section 3 (15 U.S.C. §717b); 18 C.F.R. Part 153	March 2013	October 2013
	Request formal Pre-Filing Review	Energy Policy Act of 2005, Section 311(d); 18 C.F.R. § 157.21	December 21, 2011	January 11, 2012
U.S. Army Corps of Engineers (USACE)	Section 10 Permit (Joint Permit Application)	Rivers and Harbors Act of 1899 (33 USC § 403)	1st Quarter 2013	3rd Quarter 2013
U.S. Environmental Protection Agency (EPA)	SPCC Plan	Clean Water Act (33 U.S.C. §1321(j))	Prior to Construction	Prior to construction
	NPDES Permits	Clean Water Act (33 USC § 1342)	Prior to Construction	Prior to construction
	PSD and Nonattainment New Source Review air permits	Clean Air Act, 40 CFR 52.21	2nd Quarter 2013	4th Quarter 2013
U.S. Coast Guard (USCG) Sector San Juan	Letter of Recommendation (LOR), and Waterway Suitability Assessment and Report	Ports and Waterways Safety Act of 1972 (33 USC § 1221, et seq.) Maritime Transportation Security Act of 2002 (46 USC § 701)	Letter of Intent (LOI) and PWSA submitted December 2011	4th Quarter 2013
	Permission to establish Aids to Navigation if required as a result of LOR	33 CFR Part 66	Prior to Construction	Prior to construction

Table 1-6
Permits, Reviews, and Consultations for the Aguirre Offshore GasPort Project

Agency	Permit/Approval/Consultation	Statutory Basis/ Regulations	Actual/ Anticipated Submittal	Anticipated Receipt
U.S. Fish and Wildlife Service	Consultation for Federally listed Endangered and Threatened Species , and Incidental Take Permit if required	Endangered Species Act (ESA), 16 U.S.C. 1531	Initiated 1st Quarter 2012	4th Quarter 2013
	Consultation for potential impacts on West Indian Manatee	Marine Mammal Protection Act, ESA,	Initiated 2nd Quarter 2012	4th Quarter 2013
National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service	Consultation for Federally listed Endangered and Threatened Species and Incidental Take Permit if required	Endangered Species Act (ESA), 16 U.S.C. 1531	Initiated 1st Quarter 2012	4th Quarter 2013
	Consultation for potential impact on Essential Fish Habitat	Magnuson-Stevens Fishery Management and Conservation Act	Initiated 2nd Quarter 2012	4th Quarter 2013
	Consultation for potential impacts on Marine Mammals (except West Indian Manatee)	Marine Mammal Protection Act	Initiated 2nd Quarter 2012	4th Quarter 2013
Advisory Council on Historic Preservation (ACHP)	Provide opportunity to comment under Section 106 of National Historic Preservation Act	National Historic Preservation Act Section 106	No submittal anticipated, ACHP may comment on FERC proceeding	4th Quarter 2013
Commonwealth				
Puerto Rico Department of Natural and Environmental Resources (DNER) Departamento de Recursos Naturales y Ambientales	Federal and Commonwealth Joint Permit Application for Water Resource Alterations In Water, Including Wetlands, and submerged lands under state coastal waters, of Puerto Rico (Joint Permit Application with the EQB, PRBA, and USACE)	Organic Act of the Department of Natural and Environmental Resources, Act 23 of 1972, Section 5(h)	1st Quarter 2013	4th Quarter 2013

Table 1-6
Permits, Reviews, and Consultations for the Aguirre Offshore GasPort Project

Agency	Permit/Approval/Consultation	Statutory Basis/ Regulations	Actual/ Anticipated Submittal	Anticipated Receipt
		Regulation No. 6213 – Zoning Regulation for the Coastal Zones and the Access to Beaches and Coasts of Puerto Rico. Regulation for the Use, Vigilance, Conservation and Administration of the Territorial Waters, Submerged Lands and the Maritime Zone		4th Quarter 2013
Planning Board (PRPB) Junta de Planificación	Puerto Rico Coastal Zone Management Consistency Certificate (Joint Permit Application)	Federal Coastal Zone Management Act (CZMA), 16 U.S.C. 1456	1st Quarter 2013	4th Quarter 2013
Environmental Quality Board (EQB) Junta de Calidad Ambiental	Section 401 Water Quality Certification (Joint Permit Application)	Clean Water Act Section 401, Regulation No. 7837– PR Water Quality Standards Regulation	1st Quarter 2013	4th Quarter 2013
	Title V Operating Permit	Clean Air Act 40 CFR Part 71 Regulation No. 7985 – Regulation for the Control of Atmospheric Pollution	1st Quarter 2013	4th Quarter 2013

Table 1-6
Permits, Reviews, and Consultations for the Aguirre Offshore GasPort Project

Agency	Permit/Approval/Consultation	Statutory Basis/ Regulations	Actual/ Anticipated Submittal	Anticipated Receipt
State Historic Preservation Office Oficina Estatal de Conservación Histórica	Consult on cultural resources issues according to Section 106 of National Historic Preservation Act	National Historic Preservation Act Section 106	Initiated 2nd Quarter 2012	4th Quarter 2013
Puerto Rico Institute of Culture Instituto de Cultura Puertorriqueña	Consult and issue recommendation for construction to the Puerto Rico Permit and Endorsement Management Office	Act No. 112	1st Quarter 2013	4th Quarter 2013
Permit and Endorsement Management Office Oficina de Gerencia de Permisos (OGPe)	Prepares environmental document according to Puerto Rico Environmental Public Policy Act	Act No. 416 (2004) Puerto Rico Environmental Policy Act	1st Quarter 2013	4th Quarter 2013
	Consolidated Commonwealth Permit Filing Process	December 2009 (Law Reform Process of Puerto Rico Permits)	1st Quarter 2013	4th Quarter 2013
	Construction Permit Use Permit	Act No. 161 of December 2009	1st Quarter 2013	4th Quarter 2013
	General Consolidated Permit	Act No. 161, Regulation No. 7951 - Joint Regulation for construction projects and land use	1st Quarter 2013	4th Quarter 2013
Energy Affairs Administration Administración de Asuntos Energéticos	Serves as a liaison and coordination with the DOE and/or any federal agency to integrate energy issues at the federal level.	Act No. 73 Economic Incentives Act for the Development of Puerto Rico	Initiate 1st Quarter 2013	4th Quarter 2013

In addition to the directly affected landowners, other stakeholders will have either a regulatory jurisdiction or interest in the Project. Federal and Commonwealth agencies with permitting, review, or consultation authority are addressed in Section 1.10. AOGP has conducted agency consultations and begun a public outreach process intended to inform potentially interested stakeholders about the Project and provide an opportunity for feedback about the Project or potential concerns. Prior to submitting its request to the FERC to initiate the FERC's formal Pre-Filing Process, AOGP notified Federal and Commonwealth permitting agencies of the Project and AOGP's intent to initiate the Pre-Filing Process. AOGP has continued to consult with respective agencies to request review and approval of field survey and sampling plans, and to advance the development of other Federal and Commonwealth permit applications.

AOGP held open houses/community information sessions at the JBNERR in Aguirre on February 2 and September 20, 2012 that were opportunities for interested stakeholders to learn about the Project and ask questions in an informal setting. For each session invitations were mailed to local officials and groups and notices were posted in public locations in the Project area. AOGP has also developed a Project-specific website, available in both English and Spanish, that provides Project information and updates and access to reports and studies that have been completed to date (www.aguirregasport.com; http://en.aguirreoffshoregasport.com).

1.12 NON-JURISDICTIONAL FACILITIES

AOGP has identified several non-jurisdictional facilities[10] or actions that may have environmental impacts and that will be associated with the Aguirre Offshore GasPort. These are described below.

1.12.1 Interconnecting Facilities within the Central Aguirre Power Station

PREPA will construct piping and associated facilities within the Aguirre Plant property, beyond the flange at the end of AOGP's subsea pipeline, as required to complete the connection to the combined-cycle plant and the thermoelectric plant power station. These facilities will include a metering station, pressure reduction equipment, process gas heat exchangers, and interconnecting pipework.

The subsea pipeline will complete the physical connection and deliver the natural gas to the power station battery limit.

1.12.2 Aguirre Plant Fuel Conversion

The Aguirre Plant is PREPA's largest power facility with an installed generation capacity of 1,492 MW. PREPA developed the Aguirre Plant from 1972 to 1977 to generate electricity using No. 2 oil and No. 6 oil with twelve fuel combustion sources located in three plant areas; a combined cycle power plant, a steam power plant, and a simple cycle power block. In response to the new EPA MATS rule, and in response to the Puerto Rico Government's policy to promote the use of natural gas to lower energy cost and reduce its carbon footprint, PREPA is planning to provide the capability to burn natural gas in the two unit, 900 MW steam power plant at the Aguirre Plant. The schedule for the modifications to the steam power plant will coincide with the completion of the Aguirre Offshore GasPort Project. The Aguirre

[10] As noted in the Application and elsewhere in Resource Report 1 the FSRU will be non-jurisdictional. However, Excelerate Energy will provide an EBRV from its existing fleet to serve as the FSRU for the Project, so that construction of a new FSRU will not be required. Accordingly, the FSRU is not a nonjurisdictional facility "that will be built in association with a project." 18 C.F.R. § 380.12(c)(2).

Offshore GasPort will provide the source of natural gas that enables PREPA to implement the conversion from oil to natural gas/oil at the Aguirre steam power plant, and realize the intended environmental benefits and reduced energy cost. PREPA plans to submit the necessary permits for the fuel conversion in first quarter of 2013 and complete the equipment modifications by third quarter of 2015.

1.12.3 Determination of Need for FERC to Conduct an Environmental Review

Under certain circumstances, non-jurisdictional facilities may be subject to FERC's environmental review. In making this determination, the FERC requires applicants to address four factors that indicate the need for FERC to do an environmental review of project-related non-jurisdictional facilities. These factors include:

(1) Whether or not the regulated activity comprises "merely a link" in a corridor type project (such as a transportation or utility transmission project);

(2) Whether there are aspects of the non-jurisdictional facility in the immediate vicinity of the regulated activity which affect the location and configuration of the regulated activity;

(3) The extent to which the entire project will be within the FERC's jurisdiction; and

(4) The extent of cumulative federal control and responsibility.

Following is a discussion of the application of this procedure to the identified non-jurisdictional facilities for the Aguirre Offshore GasPort.

- With respect to factor (1), the regulated activity is not a corridor-type project or a link in a corridor type project. Therefore, this factor does not support a review of the non-jurisdictional facilities.
- With respect to factor (2), the purpose of the proposed Project is to provide service to a single customer, the existing Aguirre Plant, and therefore the Project is sited in proximity to the power station and the pipeline, by design, must connect directly to the power station. However, there are no aspects of the related non-jurisdictional facilities or actions at the power station (pipeline connection, heat exchanger, or fuel conversion) that affect the location and configuration of the proposed Project. Therefore, this factor does not support a review of the non-jurisdictional facilities.
- With respect to factor (3), the non-jurisdictional facilities are entirely outside of FERC's jurisdiction as the construction of these facilities is under the jurisdiction of the Commonwealth of Puerto Rico regulatory agencies and the USEPA, as applicable. This factor weighs against inclusion of the non-jurisdictional facility in a review by the FERC.
- With respect to factor (4), the cumulative level of federal control and responsibility over the project, the non-jurisdictional facilities and actions will be undertaken by PREPA with appropriate regulatory review by the USEPA. The proposed Project will be under review by the FERC as well as appropriate federal agencies as identified in Table 1-6. Therefore, cumulative federal control is minimal and this factor does not support FERC environmental review.

1.13 CUMULATIVE IMPACTS

Cumulative effects are the impacts on the environment resulting from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. AOGP has identified recent past, ongoing, or planned commercial, residential, or recreational/tourism projects or actions in the Project area that could potentially result in cumulative effects when combined with impacts from the Aguirre Offshore GasPort Project, discussed below.

1.13.1 Interconnecting Facilities within the Aguirre Plant

The interconnecting facilities that are being proposed to be built by PREPA within the Aguirre Plant are described above under non-jurisdictional facilities. PREPA has not yet defined the exact footprint of these activities, however the construction impact from these facilities will be contained within the existing power station property, and no cumulative impact is expected from construction.

1.13.2 Aguirre Plant Fuel Conversion

The Aguirre Plant fuel conversion is described above under non-jurisdictional facilities. By design, the fuel conversion is expected to result in a positive impact on regional air emissions, as well as contribute to lowering the cost of energy on the island of Puerto Rico. The Aguirre Offshore GasPort will provide the source of natural gas that enables PREPA to implement the fuel conversion; therefore, together these projects will result in a positive cumulative impact.

1.13.3 Reduced Fuel Oil Barge Traffic

A related benefit from the power station fuel conversion, made possible by the Aguirre Offshore GasPort Project, will be reduced fuel oil barge traffic in Jobos Bay. Fuel oil is currently delivered to the Aguirre Plant by barge. Fuel oil barges enter Jobos Bay from the west between Cayo Morillo and Cayos de Ratones through the approximately 5.6 mile long, 30 foot deep marked channel that leads to a turning basin at the Aguirre Plant. The power station receives three to four fuel oil barge deliveries per week, resulting in approximately 150 to 200 barge trips (ingress and egress) per year.

When PREPA completes conversion of the Aguirre Plant from fuel oil to natural gas, an action made possible by the proposed Aguirre Offshore GasPort, fuel oil barge deliveries are estimated to be reduced by as much as 90%, or from 150 to 200 per year currently to 15 to 20 per year. PREPA has indicated that it will retain some fuel oil in storage at the power station as back-up fuel, therefore some limited barge traffic may still occur following completion of the fuel conversion. Reducing the number of fuel oil barge trips through Jobos Bay and the National Estuarine Research Reserve will reduce the potential for fuel spills, reduce potential encounters with the endangered West Indian manatee, and reduce potential encounters with recreational boat traffic.

1.13.4 AES Ilumina Solar Photovoltaic Power Plant

AES Ilumina, a subsidiary of AES Solar, recently constructed a 24 MW photovoltaic power plant on a 138-acre site in Guayama, which is approximately eight miles northeast of the Aguirre Plant and the north end of the Aguirre Offshore GasPort Project. This project is the first utility scale solar energy project in Puerto Rico and the largest solar energy project in the Caribbean region. AES Ilumina began operation in October 2012 and sells the energy output to PREPA under a 20-year power purchase. The energy output from the project is capable of meeting the energy needs of 6,500 area households.

The purpose of the photovoltaic power plant is to reduce Puerto Rico's dependence on oil and to diversify energy sources. The AES Ilumina photovoltaic power plant was constructed and placed into service before construction will begin for the Aguirre Offshore GasPort Project. Therefore, there will be no cumulative impact on the region during construction of the Aguirre Offshore GasPort. During operation, the two projects will be complementary in that they will achieve similar goals of improving air quality, reducing energy costs, decreasing the reliance of fuel oil as an energy source, and diversifying energy sources in Puerto Rico. The Aguirre Offshore GasPort and the AES Ilumina Solar Photovoltaic Power Plant will have positive cumulative impacts.

1.13.5 Salinas Solar Park

Partner companies Sonnedix and Yarotek began construction of the Salinas Solar Park in November 2012. The 16 MW project is located on a 140-acre site in Salinas, northwest of the Aguirre Plant and the north end of the Aguirre Offshore GasPort Project. The project will include a transmission line to connect with the PREPA grid, and is scheduled to begin service in April 2013. The Salinas Solar Park is scheduled to be completed and placed into service before construction will begin for the Aguirre Offshore GasPort Project. Therefore, there will be no cumulative impact on the region during construction of the Aguirre Offshore GasPort. During operation, the two projects will be complementary in that they will achieve similar goals of improving air quality, reducing energy costs, decreasing the reliance of fuel oil as an energy source, and diversifying energy sources in Puerto Rico. The Aguirre Offshore GasPort and the Salinas Solar Park will have positive cumulative impacts.

1.13.6 Master Plan for the Renovation of Aguirre, Salinas

Historic preservation and urban planning students at the Polytechnic University of Puerto Rico developed a master plan (endorsed by the DNER and the PR Tourism Company) which presents several conceptual historic renovation projects for the Aguirre Sugar Mill and other structures throughout the Historic District buildings. The master plan also includes redevelopment of urban areas and infrastructure, including a small craft marina along the Sugar Mill pier. The ultimate objective of the master plan is to preserve the historic values of Aguirre, and organize urban and touristic development in order to stimulate the local economy. The projects identified in the master plan are conceptual and AOGP is not aware that any of the master plan projects have advanced beyond the conceptual phase. Therefore, the development and implementation of these conceptual projects are not expected to contribute to cumulative impacts with the proposed Project.

1.13.7 Management Plan for the JBNERR, Salinas/Guayama

The DNER has been developing a programmatic management plan for Jobos Bay which is revised every 5 years, with the intent to preserve the natural resources of the Bay while promoting its educational and recreational use in a sustainable manner. The JBNERR has designated areas for education, outreach and passive recreation activities, such as picnic, camping, bird watching, hiking, swimming, and snorkeling interpretative trails, boardwalks, and limited docking piers for public use. Many of these improvements have been implemented and/or constructed, and will continue to be developed to maintain and preserve Jobos Bay. Activities and projects associated with the ongoing implementation of the JBNERR management plan are expected to have positive or neutral impacts to natural resources and public users of the Bay.

1.13.8 Guayama- Punta Pozuelo Board Walk

The autonomous municipality of Guayama proposes the construction of a boardwalk in an area of approximately 8.5 acres located along State Road PR-7710, in Barrio Punta Pozuelo. The site is approximately 3 miles southeast of the Aguirre Plant and 3.5 miles northeast of the Offshore GasPort site. The proposed project will have a northerly view of Jobos Bay, and includes a passive park, gazebos, small commercial spaces, facilities for the use of kayaks, parking lots and an emblematic monument to be an observation point (Desarrollo Integral Del Sur, Inc. Undated). The project has been pending approval in the PR Planning Board since October 2011, and if approved it is not known if, or when, it would be constructed. Except for a small beach access point the project would have limited direct impact on Jobos Bay and coastal resources, and if constructed would not contribute significantly to cumulative impacts.

1.13.9 Navigation Projects within Jobos Bay

AOGP is not aware of any recent past, ongoing, or planned navigation dredging projects within Jobos Bay. The last maintenance dredging event of the existing barge channel within Jobos Bay occurred more than 10 years ago and there are no definite plans for future maintenance dredging of this channel (DNER 2009).

Although not within Jobos Bay, Chevron Philips Chemical holds a permit from the USACE (permit number SAJ-1989-00210(IP-NC) for maintenance dredging of the Las Mareas Harbor approach channel and turning basin. Las Mareas Harbor is approximately 6 miles east of the proposed Offshore GasPort site. The maintenance dredging has been planned for several years but AOGP is unaware of when, or if, the work will take place. Because of the distance between the two projects, the proposed Offshore GasPort Project and the Las Mareas Harbor maintenance dredging project will not contribute to cumulative impacts.

1.13.10 Existing Water Discharges within Jobos Bay

Within Jobos Bay there is one point source discharge with an EPA National Pollutant Discharge Elimination System permit, the Aguirre Power Station (NOAA 2011). Power station cooling water discharges through an approximately 0.8-mile-long pipe to a point at the western edge of the bay just offshore of Punto Colchones. The discharge pipe is shown on the NOAA navigation chart (see Figure 1-2). At the closest point the proposed subsea pipeline will be about 0.6 mile east of the cooling water discharge. Due to the separation in distance between the outfall and pipeline and the short duration of the temporary impacts from pipeline construction within Jobos Bay, continued operation of the power station outfall and construction and operation of the pipeline is not expected to contribute to cumulative impacts.

Operation of the FSRU and visiting LNGCs at the berthing platform will result in water discharges, including discharges with a temperature differential. Excelerate has modeled the thermal plume that would result from water discharged during operation and it will be limited to the immediate vicinity of the FSRU and LNGCs (see detailed discussion in Resource Report 2). The berthing platform will be located in the Caribbean Sea outside of Jobos Bay and separated from the bay by barrier islands, and approximately 2.2 miles from the Aguirre Plant cooling water discharge. Because any water temperature impact from operation of the Project will be limited to the vicinity of the berthing platform, outside of Jobos Bay and well removed from the existing power station discharge point, construction and operation of the Project will not contribute to cumulative impacts when considered with the existing Aguirre Plant water discharge.

1.13.11 Additional Transmission Lines

AOGP is not aware of additional transmission lines currently being considered or in construction.

[illegible] facilities for the [illegible] Dinámico Integral [illegible] Board since October [illegible] for a small beach [illegible] resources, and 2 [illegible]

[illegible] Navigation Projects within [illegible]

[illegible] not aware of any recent past, ongoing, or planned navigation dredging projects within [illegible] last maintenance dredging event of the existing barge channel within Jobos Bay occurred [illegible] ago and there are no definite plans for future maintenance dredging of this channel [illegible]

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[illegible] 10 Existing Water Discharges within Jobos Bay

[illegible] Jobos Bay there is one point source discharge [illegible] National Pollutant Discharge [illegible] System permit, the Aguirre Power [illegible] through an approximately 0.8-mile [illegible] western edge of [illegible] Colchones. The discharge [illegible] closest point the proposed subsea pipeline [illegible] to the separation in distance between [illegible] and the short duration [illegible] from pipeline construction [illegible] operation of the [illegible] construction and operation of the pipeline [illegible] to cumulative [illegible]

[illegible] of the FSRU and visiting LNGCs at the [illegible] will result in [illegible] discharges with a temperature differential. Excelerate has modeled the thermal [illegible] from water discharged during operation and it will be [illegible] immediate [illegible] (see detailed discussion in Resource Report [illegible] The berthing platform [illegible] Caribbean Sea outside of Jobos Bay and [illegible] 2.2 miles from the Aguirre Plant [illegible] operation of the Project will be [illegible] berthing platform [illegible] well removed from the existing [illegible] will not contribute to cumulative [illegible] to the existing Aguirre [illegible]

[illegible] Additional Transmission Lines

[illegible] of additional [illegible]

excelerate energy®

Aguirre Offshore GasPort Project

Docket No. CP13-__-000

Resource Report 2 – Water Use and Quality

April 2013

Aguirre Offshore GasPort Project

Resource Report 2 – Water Use and Quality

Information	Location in Resource Report
Minimum Filing Requirements	
1. Identify all perennial surface waterbodies crossed by the proposed project and their water quality classification. (§ 380.12(d)(1)) • Identify by milepost • Indicate if potable water intakes are within 3 miles downstream of the crossing.	Section 2.1.1 and Figure 2-1
2. Identify all waterbody crossings that may have contaminated waters or sediments. (§ 380.12(d)(1)) • Identify by milepost • Include offshore sediments.	Section 2.1.2
3. Identify watershed areas, designated surface water protection areas, and sensitive waterbodies crossed by the proposed project. (§ 380.12(d)(1)) • Identify by milepost	Section 2.1.1 and Figure 2-2
4. Provide a table (based on NWI maps if delineations have not been done) identifying all wetlands, by milepost and length, crossed by the proposed project, and the total acreage and acreage of each wetland type that would be affected by construction. (§ 380.12(d)(l&4))	Section 2.1.1 and Figure 2-1
5. Discuss construction and restoration methods proposed for crossing wetlands, and compare them to staff's Wetland and Waterbody Construction and Mitigation Procedures. (§ 380.12(d)(2))	Addressed in Resource Report 3
6. Describe the proposed waterbody construction, impact mitigation, and restoration methods to be used to cross surface waters and compare to the staff's Wetland and Waterbody Construction and Mitigation Procedures. (§ 380.12(d)(2)) • Although the Procedures do not apply offshore, the first part of this requirement does apply. Be sure to include effects of sedimentation, etc. This information is needed on a mile-by-mile basis and will require completion of geophysical and other surveys before filing. (See also Resource Report 3.)	Section 2.4.1
7. Provide original National Wetlands Inventory (NWI) maps or the appropriate state wetland maps, if NWI maps are not available, that show all proposed facilities and include milepost locations for proposed pipeline routes. (§ 380.12(d)(4))	Figure 2-1
8. Identify all U.S. Environmental Protection Agency (EPA)- or state- designated aquifers crossed. (§ 380.12(d)(9)) • Identify the location of known public and private groundwater supply wells or springs within 150 feet of construction.	Section 2.2.2 and Figure 2-5
9. Identify proposed mitigation for impacts on groundwater resources.	Section 2.5
10. Discuss the potential for blasting to affect water wells, springs, and wetlands, and associated mitigation.	NA
11. Identify all sources of hydrostatic test water, the quantity of water required, methods for withdrawal, and treatment of discharge, and any waste products generated.	Section 2.4.1

Information	Location in Resource Report
12. If underground storage of natural gas is proposed, identify how water produced from the storage field will be disposed.	NA
13. If salt caverns are proposed for storage of natural gas, identify the source locations, the quantity required, the method and rate of water withdrawal, and disposal methods.	NA
14. For each waterbody greater than 100 feet wide, provide site-specific construction mitigation and restoration plans.	See Resource Report 3
15. Indicate mitigation measures to be undertaken to ensure that public or private water supplies are returned to their former capacity in the event of damage resulting from construction.	Section 2.4.3
16. Describe typical staging area requirements at waterbody and wetland crossings.	Section 2.4
17. If wetlands would be filled or permanently lost, describe proposed measures to compensate for permanent wetland losses.	See Resource Report 3
18. If forested wetlands would be affected, describe proposed measures to restore forested wetlands following construction.	NA
19. Describe techniques to be used to minimize turbidity and sedimentation impacts associated with offshore trenching, if any.	Section 2.4

Notes:
NA – Not Applicable

Federal Energy Regulatory Commission Comments and Responses	
Comment	**Location in Resource Report**
1. In Section 2.1.1, Site Waterbodies and Wetlands:	
a) Provide a table that identifies impacts, in acres, associated with the construction and operation of the project on the seabed, including quantifying the impacts to the diverse marine habitats (mangroves, mud flats, salt marshes, sea grasses, and coral reefs) in Jobos Bay. In addition, provide a map that shows the locations of the marine habitats in relation to the proposed project facilities' permanent areas and temporary workspaces.	1a) Table 2-4 in Section 2.1.1 and Figures 2-3, 2-4 and 2-5
b) Table 2-2 provides water column temperature and salinity profiles within the Ichthyoplankton Transect Study Area Offshore GasPort and references the University of Puerto Rico. Update the references to include this study and provide detailed metadata information related to the data described in table 2-2, specifically the location and time of each transect. (Section 2.1.1, Site Waterbodies and Wetlands)	1b) Reference added to Section 2.5. Table 2-2 updated with location and time data

Federal Energy Regulatory Commission Comments and Responses	
Comment	**Location in Resource Report**
2. Provide the following information related to the hydrostatic testing: a) whether the portable intake pumps would be located on the off-shore terminal, the lay barge, or on land; b) factors that would dictate whether the pipeline would be tested in one segment or in multiple segments; c) whether the discharge of the test water would create a plume that would be observable from the surface; d) the measures that would be taken to minimize scour from the discharge; e) how the "ultimate installation methodology" would affect the testing approach; and f) Aguirre's intent in treating the hydrostatic test waters. Resource Report 1 (page 1-9) indicates that the test water would not be treated when it is injected. However, section 2.3-1 indicates that treatment is "not anticipated" but contains a contingency statement if treatment is required. Provide information on how the test water under the treatment scenario would be neutralized when released. (Section 2.3.1, Water Use During Construction)	2a) Section 2.3.1 2b) Section 2.3.1 2c) Section 2.3.1 2d) Section 2.3.1 2e) Section 2.3.1 2f) Section 2.3.1
3. In Section 2.3.2: a) Indicate the extent of possible variation from the "standard" uptake rates provided in table 2-7 and whether the uptake rates are based on continuous year-round operation of the FSRU. b) Table 2-7 indicates that, of the 0.30 million gallons per day (mgd) of water taken up as seawater and converted to freshwater, 0.27 mgd would be discharged. This leaves 0.03 mgd that would not be discharged. On page 2-14 under "Outfall 005 – Sanitary Treatment System," reference is made to a 1 percent usage volume for sanitary system support or approximately 300 gallon per day (gpd) of black/gray wastewater to be off-loaded from the FSRU and berthing platform. Explain what happens to the remaining 29,700 gpd (i.e., 0.03 mgd x 99 percent) that is not discharged and not offloaded as sanitary waste. c) Provide an estimated uptake flow rate for seawater during firewater use. d) Explain if the volume of treated bilge water to be discharged is included in the volume estimate for ballast water or whether this should constitute a separate discharge volume. e) Discuss how uptake rates and mesh sizes for the various water intakes accord with any relevant federal and state standards relating to impingement and entrainment of aquatic biota. (Section 2.3.2, FSRU)	3a) Section 2.3.2 3b) Section 2.3.2 3c) Section 2.3.2 3d) Section 2.3.2 3e) Section 2.3.2
4. Explain the methodology used to install the subsea pipeline in those areas where "direct placement" is not feasible (i.e., in those areas with coarser grained sediments or rock/coral outcrops). In particular, describe the installation method that would be utilized in coral areas. Explain how water/sediment quality would be impacted if methodologies other than "direct lay" (e.g., jetting) are proposed. (Section 2.4-1, Subsea Pipeline)	Section 2.4.1
5. Section 2.4.1 states that re-suspension of fine grain sediments would result in an increase in turbidity and localized drift. Provide the percentage of fine grain sediments at the site and quantitative estimates of turbidity and drift. In addition, the text states that sediment disturbance would be confined to the immediate linear area around the subsea pipeline. Quantify "immediate." (Section 2.4-1, Subsea Pipeline)	Section 2.4.1

Federal Energy Regulatory Commission Comments and Responses	
Comment	**Location in Resource Report**
6. Quantify the potential depth of scour (and related impact acreage total) from the facility and subsea pipeline (Section 2.4-1, Subsea Pipeline)	Section 2.4.1.3
7. Section 2.4.1 states that the "concentrations of chemical constituents in sediments are not generally problematic even if re-suspended." Clarify how this conclusion was determined. Maximum sediment concentrations are greater than the Effects Range-Low for five of the constituents in table 2-4. (Section 2.4-1, Subsea Pipeline)	Section 2.4.1
8. Section 2.4.1 states that the net increase in thermal loading is expected to be local. Quantify "local" and support the conclusion with data. (Section 2.4-1, Subsea Pipeline)	Section 2.4.3
9. For the thermal plume modeling study, the ambient current speed that was used was 0.10 meter/sec. However, this value corresponds to the average surface currents in Jobos Bay as a whole, and does not appear to be consistent with the metocean conditions at the location where the thermal discharge would occur. Clarify the current speed used in the thermal plume modeling study. (Appendix 2A, Section 1.0, Introduction)	Appendix 2A, Section 1.0

RESOURCE REPORT 2
WATER USE AND QUALITY

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Appendix 2A Thermal Plume Modeling Study

LIST OF ACRONYMS AND ABBREVIATIONS

Aguirre Plant	Aguirre Power Complex
AOGP	Aguirre Offshore GasPort, LLC
BMPs	Best Management Practices
BOD	Biological Oxygen Demand
BWTS	Ballast Water Treatment System
CCC	Continuous Chronic Criteria
CMC	Continuous Maximum Criteria
cm/sec	Centimeters per second
EPA	United States Environmental Protection Agency
ERL	Effects Range Low
ERM	Effects Range Median
oF	Degrees Fahrenheit
FEIS	Federal Environmental Impact Statements
FERC	Federal Energy Regulatory Commission
FSRU	Floating Storage and Regasification Unit
ft/sec	Feet per Second
IMO	International Maritime Organization
JBNERR	Jobos Bay National Estuarine Research Reserve
Km	Kilometers
LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier
m	Meters
m/sec	Meters per second
m3/hr	Cubic Meters per Hour
MGPS	Marine Growth Preventative System
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee
MGD	Million Gallons Per Day
mg/Kg	Milligrams Per Kilogram
mg/L	Milligrams Per Liter
MLW	Mean Low Water
MSD	Marine Sanitation Device
NERR	National Estuarine Research Reserve
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetland Inventory
OWS	Oil Water Separator
PSI	Pounds per Square Inch
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
ppth	Parts Per Thousand
PRASA	Puerto Rico Aqueduct and Sewerage Authority
PREPA	Puerto Rico Electric Power Authority

LIST OF ACRONYMS AND ABBREVIATIONS (cont.)

PREQB	Puerto Rico Environmental Quality Board
PRSC	Puerto Rico Coastal Shoreline Segment
PRWQSR	Puerto Rico Water Quality Standard and Regulation
PSI	Pounds Per Square Inch
SRCS	South Region Coastal Shoreline
STD	Salinity/Temperature/Depth
SVOC	Semi-Volatile Organic Compound
TSS	Total Suspended Solids
USGS	United States Geological Survey

RESOURCE REPORT 2
WATER USE AND QUALITY

INTRODUCTION

Aguirre Offshore GasPort, LLC (AOGP), a wholly owned subsidiary of Excelerate Energy L.P. (Excelerate Energy) is proposing to develop, construct, and operate the Aguirre Offshore GasPort Project (Project) to be located in Salinas, along the southern shore of the Commonwealth of Puerto Rico in Commonwealth waters. The Project is being developed in cooperation with the Puerto Rico Electric Power Authority (PREPA) for the purpose of receiving and storing liquefied natural gas (LNG) to be acquired by PREPA, regasifying the LNG, and delivering natural gas to PREPA's existing Aguirre Power Complex (Aguirre Plant). The Project will include an LNG terminal and facilities that will be sited, constructed and operated pursuant to Section 3 of the Natural Gas Act (NGA), 15 U.S.C. § 717b.

The Project will utilize Excelerate Energy's proven Energy Bridge™ technology to receive, store and vaporize LNG for delivery as natural gas utilizing one of Excelerate Energy's existing Energy Bridge Regasification Vessels (EBRVs) functioning as a floating storage and regasification unit (FSRU). The FSRU will have a storage capacity of approximately 150,900 m^3 of LNG. PREPA will contract for 100% of the available capacity (storage and delivery throughput) from the FSRU. The FSRU will operate in the closed-loop regasification mode and will have the capability of sustained delivery up to approximately 500 MMscf/d of natural gas and peak delivery up to approximately 600 MMscf/d. LNG will be delivered to the Project via LNG carriers (LNGCs), unloaded and stored within an FSRU, regasified on the FSRU, and delivered directly to the Aguirre Plant by a subsea pipeline.

Construction, operation and maintenance of the Project may have associated impacts on the surface waters surrounding its proposed location.

PURPOSE OF REPORT

The purpose of this report is to identify and describe the surface water and groundwater resources present within the project area and the potential impacts associated with the construction, operation and maintenance of the Project on the identified surface water and groundwater resources.

AGENCY COMMUNICATIONS

Natural resource or environmental quality agencies consulted for information about the surface water and groundwater resources present included telephone communications and electronic mail (e-mail) exchanges with water resource staff in USEPA Region 2 and the Puerto Rico Environmental Quality Board (PREQB).

REPORT ORGANIZATION

Resource Report 2 is prepared and organized according to the Federal Energy Regulatory Commission (FERC) Guidance Manual for Environmental Report Preparation (August 2002). This report is organized into four major sections and a separate section listing the sources used to prepare this report. Section 2.1 describes the surface water resources in the Project area; Section 2.2 describes the groundwater resources. Section 2.3 addresses Project Water Use and Section 2.4 addresses the potential and anticipated Environmental Consequences of that water use by the Project.

2.1 SURFACE WATER RESOURCES

2.1.1 Site Waterbodies and Wetlands

The most prominent surface water bodies associated with the Project are the coastal bay waters of Jobos Bay and the offshore pelagic waters surrounding the bay area of the Caribbean Sea. The proposed pipeline path extends approximately 4.1 miles from the proposed GasPort located outside of Jobos Bay (Mile Post (MP) 0) extending through the Boca del Inferno inlet (MP 1.0 to ~MP 1.8) and extending across the basin of Jobos Bay (MP 1.8 to MP 4.0) to the Aguirre Plant where the pipeline feeds into the Aguirre Plant (MP 4.1) (Figure 2-1).

Jobos Bay is located on the south-central coast of Puerto Rico centered at 17° 56'N and 66° 13'W, between the municipalities of Salinas and Guayama. Jobos Bay is the second largest estuary in Puerto Rico and is classified as a coastal plain estuary (Whitall et al., 2011). The entire Jobos Bay covers an estimated 2,718 acres and is defined by the higher high water line and seaward. Uses in Jobos Bay include maintenance of shipping channels to support harbors, commercial and recreational fishing, recreational boating/diving and research. The main navigation channel is 46 meters (m) wide by 8.3 m deep (150 feet wide by 27 feet deep) and is maintained only as required, with the last maintenance occurring more than ten years ago (Jobos Bay National Estuarine Research Reserve (JBNERR), undated).

Jobos Bay provides a natural harbor protected from offshore wind and waves by a series of mangrove islands in the southwest and Punta Pozuelo in the southeast. Jobos Bay features diverse marine habitats, including mangroves, mud flats, salt marshes, sea grasses and coral reefs. Portions of the bay have been classified as one of the 26 National Estuarine Research Reserves (NERR) designated by the National Oceanic and Atmospheric Administration (NOAA) (Figure 2-2 as adapted from Whitall et al. 2011). The pipeline path bisects edges of the areas designated as NERR between MP 1.5 to MP 2.0 (Figure 2-2). The goal of the NERR program designation is:

> *To promote the establishment and management, through Federal-State cooperation, of a national system of Estuarine Research Reserves representative of the various regions and estuarine types in the United States. Estuarine Research Reserves are established to provide opportunities for long-term research, education and interpretation (Jobos Bay Management Plan 2010-2015).*

The bay and its adjacent nearshore waters are relatively shallow and secchi transparency ranges from 0.9 m to 4 m (3 to 13 feet) (Morelock J. et al. 2011 in Whitall et al., 2011). Jobos Bay and the offshore Caribbean Sea are entirely marine with salinities ranging 34 to 36 parts per thousand (ppth) (CREE, 1981). Generally, temperature-salinity patterns at Jobos Bay oppose one another as high salinities occur with low temperatures during the dry winter months (December-April), while the opposite situation prevails in the wet summer (May-November) (PRNC, 1975 In Dieppa et al. 2008). Average water temperatures range from 25 to 26 °C (77 to 78.8 °F) in the winter to 28 to 29 °C (82.4 to 84.2 °F) in summer. At the single sampling historical station, located 1,625 feet southwest of the Aguirre Plant dock towards Mar Negro, temperatures exhibited a seasonal pattern ranging from 26.2°C (79.1 °F) in December, to 30.0°C (86 °F) in September, while salinities ranged from 33.6 ppth in August, to 36.3 ppth in April. The peak temperature during 1975 was 35.9°C (96.6 °F), sampled on May 31, 1974, near the thermal discharge from the Aguirre Plant. Minimum temperatures were observed in January, 1974 (24.9°C/76.8 °F) and January, 1975 (25.40°C/77.7 °F) (Dieppa, A. et al. 2008).

Freshwater discharge to the bay is limited to smaller tributaries and groundwater discharge. Due to the dry climate and low rainfall, surface runoff to Jobos Bay and surrounding waters usually only occurs during the wettest months of September through November (Ewel and Whitmore, 1973 In Whitall et al., 2011). As a result, most of the watershed's natural stream beds are only intermittently flooded throughout the year. Río Seco, in the east, is the only major river that discharges into Jobos Bay seasonally. Quiñones-Aponte et al. (1997 In Whitall et al. 2011) described that year-round stream flow is limited by where most streams meet the highly porous fan delta deposits.

Marine waters within Jobos Bay are open pelagic marine waters. Based upon NOAA bathymetry mapping, water depths vary but are generally shallow and range 10 to 20 feet mean low water (MLW). Bottom substrates vary between coral out crops and hard bottom to soft muds. Maximum depth within the bay is approximately 32.5 feet (Field et al. 2003). Water depths in the open pelagic waters offshore from Jobos Bay in the area of the proposed Offshore GasPort are in the range of 60-65 feet MLW. Open ocean waters flow easterly along the bottom of the Aguirre navigation channel and into Jobos Bay. The typical tidal flow pattern is for Westward flow during ebb tide and Eastward flow during flood, tide, a pattern that can be overridden near the surface by strong winds. The prevailing easterly and southeasterly winds intensify westward flow during ebb tide and might cancel, or even reverse, the eastward flood surface flow. The mean flow through Cayos Caribe is towards the northwest into the mouth of the Bay and Mar Negro. The tide channel, which contains the navigation channel, is 25 to 35 feet MLW deep and connects to the sea through shallow surge channels between the islets of Cayos Caribes, Cayos de Barca, and through Boca del Infierno. Surface currents in the Bay and the navigation channel normally average 0.33 feet/second (ft/sec), ranging from 0.0 to 0.82 ft/sec (Field et. al., 2008). Average tide height in Jobos Bay is 0.45 feet with a more typical range in tides being 0.56 to 1.18 feet (Field et al. 2008). Near surface, general water quality data collected from the surface of waters surrounding the location of the proposed GasPort are presented in Table 2-1. Table 2-2 presents the temperature and salinity profiles in the water column at each of the ichthyoplankton transect sampling points. Temperature profiles indicate that at these depths no thermocline is present and that the waters are likely subjected to routine mixing. Salinity is consistent throughout the water column as well.

Table 2-1
Summary of Surface Water Quality Data Collected at the Surface (0 m) in Waters Offshore from Jobos Bay (May 2012)

Water Quality Parameter	Minimum	Maximum	Mean
Temperature (°C)	27.8	27.9	27.8
pH (su)	8.03	8.12	8.09
Salinity (ppt)	29.1	30.2	29.4
Conductivity (mS/cm)	47,590	49,120	47,956
Dissolved Oxygen (mg/L)	5.34	8.65	7.54
Percent Saturation of Dissolved .Oxygen.	78.1	120	108

Source: Data recorded during the May 2012 ichthyoplankton survey.

Table 2-2
Water Column Temperature and Salinity Profiles within Ichthyoplankton Transect Study Area of Offshore GasPort

	Transect 1 (Lat. 17o54.55' Long 66o13.57; 15:31 hrs.)		Transect 2 (Lat. 17o54.64' Long 66o13.28; 15:00 hrs.)		Transect 3 (Lat. 17o54.68' Long 66o12.90; 14:29 hrs.)		Transect 4 (Lat. 17o54.68' Long 66o12.54; 16:16 hrs.)	
Depth (ft.)	Temp. (°C)	Salinity (ppt)	Temp. (°C)	Salinity (ppth)	Temp. (°C)	Salinity (ppt)	Temp. (°C)	Salinity (ppt)
3.3	28.05	35.43	28.08	35.43	28.02	35.43	28.08	35.42
6.5	28.05	35.43	28.08	35.43	28.02	35.43	28.08	35.43
9.8	28.05	35.43	28.08	35.43	28.01	35.43	28.08	35.43
13.0	28.05	35.43	28.07	35.43	28.01	35.43	28.08	35.43
16.3	28.05	35.43	28.07	35.43	28.01	35.43	28.08	35.43
19.5	28.04	35.43	28.07	35.43	28.02	35.43	28.08	35.43
22.8	28.04	35.43	28.06	35.43	28.02	35.43	28.08	35.43
26.0	28.02	35.43	28.06	35.43	28.01	35.44	28.07	35.43
29.3	28.00	35.44	28.05	35.43	27.99	35.44	-	-
32.5	27.99	35.44	28.05	35.43	27.98	35.44	-	-
35.8	27.98	35.44	28.05	35.43	27.97	35.44	-	-
39.0	27.96	35.45	28.04	35.43	27.97	35.44	-	-
42.3	27.92	35.46	28.04	35.43	27.96	35.45	-	-
45.5	27.88	35.48	28.03	35.43	-	-	-	-

Source: Data recorded by University of Puerto Rico during the May 2012 ichthyoplankton survey.
Notes: Depth shallower than Transect 1 and 2; ppth-Parts per thousand (ppth)

Review of the National Wetlands Inventory (NWI) maps for Jobos Bay identified two wetland designation categories, E1UBL and M1UBL, as being crossed by the proposed pipeline or Offshore GasPort (Figure 2-1). Table 2-3 summarizes the NWI wetlands along the proposed pipeline route and GasPort. Table 2-4 presents the acreages of submerged vegetation cover types and coral communities subject to potential disturbance during the project construction phase as detailed in Resource Report 3. No mangrove, tidal mudflats or salt marshes are impacted by the project.

Table 2-3
Summary of Designated NWI Wetland Codes Crossed by Project

NWI Wetland Code	Designation Code Description	Project Feature	Project Mile Post Segment and Est. Acreage for Permanent Operational Need [1]
M1UBL	Marine, Subtidal, Unconsolidated Bottom, Permanently Flooded	Submarine Pipeline and Offshore Berthing Platform – MP 0 to MP 1.8	~22.3 acres (Berthing Platform) ~4.2 acres (Pipeline)1
E1UBL	Estuarine, Subtidal, Unconsolidated Bottom, Permanently Flooded	Project Submarine Pipeline – MP 1.8 to MP 4.1	~5.5 acres (Pipeline)1

Source: United States Fish and Wildlife (USFWS) National Wetlands Inventory Mapper (http://107.20.228.18/Wetlands/WetlandsMapper.html#)
[1] *Assumes a 1.5 foot diameter pipe along pipeline pathway and a 20 foot wide operational right of way width of disturbance*

Table 2-4
Summary of Acreages of Vegetation and Coral Covertypes Potentially Affected by the Project

Benthic Covertype	Covertype Community Description	Project Segment	Estimated Acreage (Acres)1
Macroalgae and Seagrass Community	Mixed macroalgae seagrass species	Pipeline	2.96
Coral Reef Community	Coral Reef	Pipeline	0.9

[1] *Based on acreage estimates as presented in Resource Report 3 for the project pipeline right of way of 20 feet*

Figures 2-3 through 2-5 depict the distribution of macroalgae, seagrass, unvegetated substrates and corals along the project path. No mangrove or intertidal mud flats are affected by the project.

Jobos Bay and the adjacent offshore waters are located in the South Region Coastal Shoreline (SRCS) within the Puerto Rico Coastal Segmentation Unit PRSC34 which extends along the shoreline approximately 41 miles from Punta Ola Grade to Punta Petrona, inclusive of Jobos Bay (PREQB, 2010). The PREQB 305(b) and 303(d) integrated report (PREQB, 2010) lists PRSC34 as Category 5 waters (non-attainment) for primary contact recreation and aquatic life standards at select stations. The segment was identified as Category 1 waters (full attainment) for secondary contact uses (recreational swimming, fishing and boating). Category 5 waters are waters where at least one water quality standard was not attained (impaired or non-supporting of designated uses). Causes for the non-attainment for the primary contact and aquatic life impairment within PRSC34 include pH, low dissolved oxygen levels, elevated fecal coliforms and Enterococcus counts, and turbidity. Sources of pollution to assessment unit PRSC34 include major industrial point sources, agricultural runoff, urban runoff and storm sewers, wastewater systems and upstream impoundments (PREQB, 2010).

2.1.2 Surface Water Classification

The Puerto Rico Water Quality Standards Regulation (PRWQSR) establishes the designated uses to be maintained and protected for all waters in the archipelago of Puerto Rico (PRWQSR, 2003). The uses include: 1) protection and propagation of fish, shellfish and wildlife; 2) direct and indirect contact recreation, and; 3) raw source of drinking water (PREQB, 2010).

Marine waters of Puerto Rico are classified as Class SA, SB, SC, SD or SE waters. The marine waters encompassing Jobos Bay and extending offshore are classified as SB by the PREQB (EPA Region 2, 2012). Class SB waters are coastal or estuarine waters intended for use in primary and secondary contact recreation, and for propagation and preservation of desirable species, including threatened and endangered species (PREQB, 2010).

Class SB includes the area of coastal and estuarine waters extending from mean sea level of the shoreline up to 0.3 miles seaward. Beyond this limit, the next less restrictive classification will apply to a maximum of approximately 10.4 miles seaward (PREQB, 2010). Based upon this definition, the proposed pipeline route will include classification SB in near shore waters and Class SC waters for segments that are 0.3 miles from the nearest shoreline to a maximum of approximately 10.4 miles from the shoreline.

Class SC waters include coastal waters intended for primary contact recreation use from the zone subject to the ebb and flow of tides (mean sea level) to 3.0 miles seaward, and secondary contact recreation from

3.0 miles seaward to 10.4 miles seaward, and for the propagation and preservation of desirable species, including threatened and endangered species (PREQB, 2010).

Water quality standards for Class SB and SC waters are summarized in the PRWQSR, as administered by the PREQB (PREQB, 2010) and can be referenced at the EPA web page (http://water.epa.gov/scitech/swguidance/standards/wqslibrary/pr_index.cfm).

2.1.3 Sediment Quality Assessment of Jobos Bay

The proposed pipeline will be constructed and maintained on the marine subsea bottom of Jobos Bay, extending out past the coastal mangrove areas, through the Boca del Inferno inlet into the adjacent waters of the Caribbean Sea.

NOAA conducted a stratified random sediment sampling effort of soft and hard bottom sediment types present in Jobos Bay as part of the baseline assessment for the bay environment (Whitall et al., 2011). A total of 44 sites were targeted for sediment sample collection and chemical analysis for polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl congeners (as total PCBs), organochlorine pesticides, butyltins and metals. The purpose of the sampling effort was to provide preliminary data for the baseline assessment of ecological resources of Jobos Bay. For characterizing sediment quality within the bay, analytical data for the collected sediments were compared to analytical data from other local waters from Puerto Rico and effects range low (ERL) and effects range median (ERM) NOAA National Status and Trends sediment quality guidelines (Long et al. 1996; Long and Morgan, 1990). Concentrations below the ERL are not considered to pose a risk to benthic communities and concentrations above the ERM are expected to have some degree of negative effect (Long et al. 1996; Long and Morgan, 1990). These data were the most recent sediment quality data available for the project site area.

Table 2-5 presents a summary of analytical data for the sediment quality assessment conducted by Whitall et al., (2011).

Table 2-5
Summary of Analytical Data[1] (mg/Kg) for Study Area Sediment Samples from Jobos Bay Compared to ERLs and ERMs

Chemical Constituent	ERL (mg/Kg)	ERM (mg/Kg)	Minimum (mg/Kg)	Maximum (mg/Kg)	Mean (mg/Kg)
Total PAHs	4.02	44.7	0.004	14.25	1.06
Total PCBs	0.023	0.18	0.00003	0.019	0.0021
Total DDT	0.00158	0.0461	0 (ND)2	0.0033	0.00054
Tributyltin	NA[3]	NA	0 (ND)	0.0109	0.00056
Silver	1	3.7	0.051	0.219	0.118
Aluminum	NA	NA	629	73,700	39,138
Arsenic	8.2	70	1.79	28.1	12.6
Cadmium	1.2	9.6	0 (ND)	0.174	0.008
Chromium	81	370	0 (ND)	29.8	18.2
Copper	34	270	1.37	73.7	33.83
Iron	NA	NA	1,060	50,500	26,570
Mercury	0.15	0.71	0.0014	0.144	0.0432
Manganese	NA	NA	33.1	1,130	510.6

Table 2-5
Summary of Analytical Data[1] (mg/Kg) for Study Area Sediment Samples from Jobos Bay Compared to ERLs and ERMs

Chemical Constituent	ERL (mg/Kg)	ERM (mg/Kg)	Minimum (mg/Kg)	Maximum (mg/Kg)	Mean (mg/Kg)
Nickel	20.9	51.6	0 (ND)	31	11.0
Lead	46.7	218	0.227	16.7	7.15
Antimony	2	25	0 (ND)	0.589	0.217
Selenium	NA'	NA	0 (ND)	1.56	0.332
Tin	NA	NA	0 (ND)	2.74	1.13
Zinc	150	410	1.57	117	54.2

Source: Whitall et al. (2011)
[1] *ND- Constituent below detection limits*
[2] *NA – Sediment quality guideline not available*
[3] *ERL/ER-M – Effects Range-Low / Effects Range - Median*

Whitall et al. (2011) noted that results of the sampling effort revealed contaminants to be higher in sediments collected from the inner bay (e.g., closer to the shoreline) versus offshore areas of the bay. This is likely due to the influence of land use activities, surface runoff, riverine and tributary inputs. General trends observed in contaminant distribution included a close association between finer grained sediments and total organic carbon with contaminant concentrations and a general increase in concentration of contaminants in the eastern areas of the bay versus the central and western portions of the survey areas.

Whitall et al. (2011) observed that the concentrations of the above contaminants were comparable to other areas of Puerto Rico and concluded that the levels of chemical contaminants in the sediments were generally below established sediment quality guidelines suggesting that impacts on infaunal biota were unlikely. The lack of exceedance of the upper threshold sediment quality value (i.e., ERM value) and the comparability of contaminant concentrations to other coastal areas of Puerto Rico indicate that sediments within the Jobos Bay system are not significantly impacted by anthropogenic sources. No sampling of the sediments from offshore of the Boca del Infierno inlet was conducted and analytical data on sediment quality was lacking in this area.

2.1.4 Current Water Use

Major water uses for the marine waters of Jobos Bay and the adjacent waters include commercial fishing, recreational uses (i.e., tourism, swimming/beaches, boating, scuba diving etc.), industrial uses (i.e., cooling water withdrawal, treated/process water discharges) and scientific research (i.e., JBNERR).

Jobos Bay and the adjacent waters of the Caribbean Sea provide significant resources for commercial and recreational fishing. A 2008 census of part time and full time commercial fishermen in Puerto Rico revealed a multi-gear and multi-species fishery to be present. Along the south shore of the island, primary fisheries included reef fishes, deep water snappers, pelagic fish, lobster, conch, octopus and other species for ornamental display, bait and pet trades (Matos-Caraballo and Agar, 2011).

Industrial uses of the waters of the bay include use as a source of cooling water supply and for permitted assimulative capacity for pollutant discharges administered through the National Pollutant Discharge

Elimination System (NPDES) permitting system (PREQB, 2010). An example industrial use is the water withdrawal intake for cooling water purposes for the Aguirre Plant.

Portions of Jobos Bay have been designated as a NERR by NOAA for purposes of estuarine research studies in tropical marine ecosystems (Figure 2-2).

The JBNERR integrates science, education, training and stewardship to address relevant topics for demonstrating and facilitating objective problem-solving and best management practices (BMPs) to conserve and restore coral and coral-related ecosystem resources (JBNERR, undated).

2.2 GROUNDWATER RESOURCES

Principal aquifers in Puerto Rico consist mostly of limestone, alluvium, or volcanic rocks. An aquifer system consists of a heterogeneous body of inter-bedded permeable and poorly permeable material that functions regionally as a water-yielding hydraulic unit; it comprises two or more permeable beds (aquifers) separated at least locally by confining units that impede ground-water movement but that do not greatly affect the regional hydraulic continuity of the system (USGS, 1999). Groundwater resources on the island of Puerto Rico consist of a multiple aquifer complex. Freshwater stream flow infiltration and infiltration from precipitation are the most important source of groundwater recharge to the underlying aquifer.

The Jobos Bay watershed is within the South Coastal Plain aquifer that extends from the bedrock hills near the watershed's northern boundary to the southern coastline with the bay. According to Quiñones-Aponte et al. (1997 In Whitall et al., 2011), there are two discrete groundwater units in the south coastal zone, a shallow aquifer between 9.8 feet and 75.5 feet thick and a deep aquifer below. The shallow aquifer is believed to supply the mangrove complex at the watershed's coastal margins, while the deep aquifer may provide freshwater to the offshore mangrove islands that form Jobos Bay's southern boundary perimeter forming the offshore border of the bay complex (Whitall et al. 2011).

Groundwater resources of Puerto Rico are classified into two class designations:

Class SG1 – Groundwaters designated as sources of drinking water supply and for agricultural uses, including irrigation. Also included under this class are those groundwaters that flow into waters, which support ecological communities of exceptional ecological value in accordance with the PRWQSR.

Class SG2 – Groundwaters which due to the high dissolved solids concentration (concentrations >10,000 mg/L) are not fit as sources of drinking water supply even after treatment. There are promulgated water quality standards for this use.

2.2.1 South Coastal Plain Aquifer

The following aquifer description is derived in whole or in part from the Groundwater Atlas of the United States: Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands (USGS, 1999).

The South Coastal Plain Aquifer in Puerto Rico extends from Patillas westward to Ponce. The aquifer consists of coalescing fan-delta and alluvial deposits that range in thickness from about 300 feet near the coast at Ponce to as much as 1,000 feet near Santa Isabel. Near the coast throughout most of the western half of the aquifer, freshwater is underlain by saline water at depths of about 250 feet or less. The aquifer generally is unconfined, but semi-confined conditions are created locally by inter bedded silt and clay layers. The aquifer consists of fine-grained material, especially near the coast and at the coalescing edges of the fans. Coarser grained material generally is present in the central and upper parts or apex of each fan. The South Coast aquifer supplies about one-half of the total public water supply and irrigation needs of the south coast. The remainder is from surface-water sources. Withdrawals from the aquifer were estimated to be about 74 million gallons per day in 1985.

Before development, regional ground-water movement was from recharge areas southward to the coast; locally. Some recharge water moves laterally to major streams, mostly in downstream reaches. Recharge to the aquifer was from infiltration of precipitation that fell directly on the alluvium and from stream flow seepage. Discharge was to streams and the sea and as direct evapotranspiration from the aquifer where the water table was shallow. The long history of construction of drainage ditches and irrigation canals and withdrawal of groundwater in this agricultural and industrial area, however, has greatly altered natural ground-water flow. Recharge has been augmented by seepage of surface water transported in the several irrigation canals that cross the alluvium and from the practice of furrow irrigation (USGS, 1999).

2.2.2 Water Supply Wells

The mainland surrounding Jobos Bay occurs within two public supply water aggregation service areas (USGS, 2008). These supply areas near equally bisect the drainage area and comprise the municipalities of Salinas and Guayama. Corresponding service area numbers are identified as Area 41 (Guayama) to the east and Area 38 (Salinas) to the west (USGS, 2008). Public supply water is provided by a combination of surface water and groundwater supply sources in both areas.

Table 2-6 summarizes the 2005 public supply area water delivery statistics for both service areas surrounding Jobos Bay.

Table 2-6
Public Supply Water Delivery Statistics for the Jobos Bay Service Areas[1,2]

Service Area No.	Service Area Served	2005 Census Population	Population. Served by PRASA2 Systems	Population. Served by non-PRASA Systems	Total Population Served	Delivery (Mgal/day)
38	Salinas	31,969	31,228	0	31,228	4.43
41	Guayama, Arroyo, Patillas	84,180	78,706	4,386	83,092	14.07

Source: USGS (2008)
[1] *Based on available water data from water year 2005 (USGS, 2008)*
[2] *Puerto Rico Aqueduct and Sewerage Authority (USGS, 2008)*

The closest water supply groundwater wells near (or within 3 miles) were identified by USEPA Region 2 and the PREQB staff (Figure 2-6). No potable water supplies were identified within 3 miles of the Offshore GasPort. Table 2-7 summarizes the water supply wells or sources closest to where the Offshore Gasport or where pipeline makes landfall with Aguirre Plant.

Table 2-7
Closest Water Supply Wells/Sources to the Offshore Gasport

Public Supply Reference[2]	Name of Well Or Well Cluster	No. of Well Locations	Distance to Offshore Terminal (Miles)	Municipality or Private Well[3]
PR0563065	AEE Aquirre Termoelec.	1	>3	Private
PR004915	Coqui	3	>3	Salinas
PR0004765	Cimarrona	1	>3	Guayama
PR0004845	Guayama Urbano	2	>3	-

Table 2-7
Closest Water Supply Wells/Sources to the Offshore Gasport

Public Supply Reference[2]	Name of Well Or Well Cluster	No. of Well Locations	Distance to Offshore Terminal (Miles)	Municipality or Private Well[3]
PR0004775	Puente Jobos	2	>3	Puente Jobos
PR0563015	Corporacion Azucarera Aguirre	1	>3	Private

Source USEPA Region 2 (2012)
[1] *Stephen Gould USEPA Region 2 personal communication with J. Schaffer, Tetra Tech, May 21, 2012.*
[2] *JAC personal communication between Edwin Rodriguez-Class Tt with Rafael Espanol, JAC May 2012*
[3] *Status unknown as to private use*

2.3 PROJECT WATER USE

2.3.1 Water Use during Construction

Hydrostatic testing of the pipeline will be performed using sea water and will represent the largest use of water during construction. Water will be pumped using portable, high volume pumps located on the offshore laybarge. The water intake will be fitted with a 100 micron screen to prevent intake of organisms. Based on volume of the pipeline, about 240,000 gallons will be required to fill and test the pipeline; however, the actual amount of water needed to complete the testing will depend on the number of hydrostatic tests required. Assuming one to three tests will be required to complete hydrostatic testing, testing will require between 240,000 and 720,000 gallons of water. Installation will involve a combination of self burial and floatation with direct laying on soft and hard bottom substrates. The pipeline has been sited to minimize impacts to seagrasses and coral reefs in these sensitive environments. Thus the water volume will be dependent upon pipeline routing. Pipe segments will be floated over hard substrates for placement with as minimal disturbance as possible to coral reef communities. During the hydrostatic test, the water volume will be pressurized within the pipeline void. The pressurized pipeline will be monitored for consistent pressure during the test for 8 hours. The number of hydrostatic tests will be determined based upon the performance standards and success in demonstrating pipeline integrity.

The pipeline will be emptied and dried upon completion of the successful hydrostatic test. Consistent with Resource Report 1, treatment of the seawater with biocide when injected into the pipeline is not anticipated. Discharge of hydrostatic water will occur at the shoreline approach of the pipeline. The discharge will be directed through a discharge pipe secured at a depth of about 6 feet below the surface to minimize surface disturbance. A diffuser head will be attached to the discharge pipe during dewatering operations. Use of a diffuser head will reduce discharge velocity and prevent sediment re-suspension at the point of discharge. Given the subsurface discharge and use of a diffuser, no surface plume is expected. AOGP will obtain all required permits and authorizations to conduct the hydrostatic tests.

2.3.2 FSRU

2.3.2.1 FSRU Intake

The FSRU will utilize the closed-loop vaporization mode which will not require direct seawater intake or discharge for LNG regasification. However, other standard vessel operations will require seawater use, whether the FSRU is in standby mode or vaporization mode. These operations include maintaining the vessel's main cooling systems, ballast water requirements, a safety water curtain during regasification, and saltwater desalination system for hoteling and sanitary purposes. Other uses for seawater may include maintaining the water deluge and fire main systems. Dedicated pumps to these emergency functions and systems will have an approximate capacity of 232,471 to 237,754 gallons/hr (880 to 900 m^3/hr). These systems will be periodically tested as part of a periodic emergency drill protocols.

The normal water use of the FSRU will be up to approximately 56 million gallons per day (MGD) on a continuous basis for standard operations. Of this volume, approximately 54 million gallons are used to support machinery cooling and the operation of the vessel's safety water curtain and then discharged. The remaining approximately 2 MGD will consist of ballast water which will be subject to fluxes dependent upon LNG cargo loading, regasification processes, vessel stability and sea conditions. Ballast management will vary with the regasification storage need and natural gas demand from the Aguirre Plant. Table 2-8 summarizes the anticipated standard intake volume requirements.

Table 2-8
Summary of Standard FSRU Water Use Intakes and Discharges1

	FSRU Seawater Intake (MGD)	FSRU Seawater Discharge (MGD)
Main Condenser Cooling System	47.0	47.0
Auxiliary Seawater Cooling System	6.0	6.0
Safety Water Curtain	0.6	0.6
Ballast Water	1.9	±1.9[2]
Freshwater Generator	0.3	0.27
Marine Growth Preventative System (MGPS)	0.16	0.16
Total	**55.96**	**55.93**

[1] *Based on standard continuous operation of an Excelerate Energy FSRU in closed loop regasification.*
[2] *Discharge based upon loading rate and buoyancy compensation needs for the FSRU*

All water used in support of FSRU operations will be drawn through four sea chests: starboard high, starboard low, port high and port low. Each sea chest will draw water through a series of grids. There will be four high sea chests grids on the starboard side and eight on the port side. Additionally, there will be six low sea chests grids on the starboard side and eight on the port side. Each sea chest grid will have metal gratings with 0.87 inch slots between the grating bars. The starboard sea chests have an open area of 8.1 ft^2 per grid and will have a total open area of 74 ft^2. The port sea chests have an opening of 6.8 ft^2 per grid and will have a total open area of 120.5 ft^2. The high sea chests will be located on the rounded portion of the hull near the bilge approximately 22.8 feet below the surface of the water, while the low sea chests will be located further down on the flat portion of the hull, with the centerline approximately 37.4 feet below the surface of the water. Seawater will be drawn horizontally through the high sea chests and vertically through the low sea chests.

The total open area for the high and low sea chests will be 195 ft^2. Under normal water use capacity, the calculated through-screen velocity of water entering the sea chests is approximately 0.45 ft/sec, a withdrawal velocity below the 0.5 ft./sec rate recommended as best available technology to minimize impingement.of aquatic life. Mesh size on grates of the seachests are 0.87 inch slots and will not act to abate entrainment of planktonic organisms. Water drawn through the sea chests will be circulated through five main vessel operating systems (Main Condenser Cooling, Auxiliary Seawater Cooling, Water Curtain, Freshwater Generator, Hoteling and Sanitary Treatment and will then be discharged at various outfall locations along the deck and hull. The Marine Growth Preventative System (MGPS) will withdraw a minor volume for the application of self-generated sodium hypochlorite (~0.5ppm) solution into the sea chests for the purpose of marine biofouling control. Consumptive volume from the freshwater generator will be used for freshwater supply for sanitary water demand, boiler make up water and potable supply. Excess water not needed during operations will be discharged as part of the freshwater generator effluent.

2.3.2.2 FSRU Discharges

During routine operations, the FSRU will operate with five primary outfalls and separate port and starboard ballast outlets. Effluent sources for each discharge via the outfalls are summarized in the following sections. Discharges will include the treated process water from daily FSRU operations and heated cooling water from the ships condensers. The largest associated discharge will be for cooling the main condenser for the FSRU. This discharge will be dedicated to Outfall 001.

Outfall 001A and B – Main Condenser Cooling

Excelerate's FSRUs utilize the steam from the on board boilers to drive the main propulsion turbine and turbo generators that provide power for the vessel's propulsion, auxiliaries, and electrical power generation. As part of the steam vessel's normal propulsion systems, seawater is used for condensing exhaust steam in the main condenser. The FSRU's main condenser cooling system will be required to operate under normal capacity of water intake and discharge conditions. During each of these periods of normal capacity water use, this system will require the dedicated intake and discharge of up to approximately 47 million gallons of seawater per day.

Intake water will circulate through the engine condenser cooling system and then be discharged through a 55-inch diameter pipe 5.3 to 7.4 meters below the sea surface. The primary role of this water will be to provide for heat dissipation in the main condenser of the FSRU. The Cornell Mixing Hydrodynamic Model (CORMIX) (Version 4.3GT, CORMIX-GI), Visual Plumes (VP) Model and JETLAG Model were used to evaluate and analyze the discharge plume created by the Main Condenser Cooling System and estimate the change in temperature of the seawater used by the system at its discharge point (Appendix 2A). The models were evaluated to determine which best fit the discharge characteristics for Outfall 001. The thermal plume modeling is based upon volume and discharge port dimensions for the FSRU. For modeling purposes, a change in surface temperature under summer conditions of approximately 12°C (based upon operating records for the Northeast Gateway Project (Tetra Tech, 2012) above the ambient temperature at intake was used to derive the proposed mixing zone. USEPA guidance (USEPA, 1991) was used to calculate a mixing zone of 201 feet for Outfall 001. Evaluation of projected plume from Outfall 001 of the FSRU was made using the Puerto Rico temperature criterion of 32.2 °C (90 °F) as the thermal compliance value. Applying an operating rise of 12 °C above ambient temperature, a maximum water temperature upon discharge from the Outfall 001 discharge was estimated to be up to 41.2 °C (106.2 °F).

The thermal plume modeling effort identified VISUAL PLUMES and JETLAG to best predict the thermal plume characteristics for Outfall 001 (Appendix 2A). Thermal plume characteristics are described and modeled based upon the momentum (discharge rate) and thermal dissipation characteristics. VISUAL PLUMES predicted the plume to be momentum driven upon discharge before becoming more buoyant and rising towards the sea surface. Attainment of the 32.2 °C (90 °F) criterion was modeled to occur at 39.7 feet in the horizontal plane from the discharge port and 38.4 feet in the vertical plane (at depth) from the discharge under no influence from ambient ocean current. When modeled with a minimal current (0.325 ft/sec), attainment of the thermal criterion occurred within 20.5 feet in the horizontal plane from the discharge port and up to 38 feet at depth (Table 2-9). The plume under a minimal current showed a more rapid transition from being momentum driven to buoyancy driven due to current deflection. Under both current scenarios, the attainment of the thermal criterion was achieved well within the predicted mixing zone.

Table 2-9
Locations at Which Temperature Criterion Are Met for FSRU Outfall 001 Based on the VISUAL PLUMES UM3 Model

Case	Discharge Depth (feet)	Ambient Velocity (ft./sec)	Criteria (32.2° C/90 °F) or Bottom Impact Temperature(° C)	Horizontal Distance to Meet Criteria or to Bottom Impact (feet)	Water Depth to Meet Criteria (feet)	Predicted Discharge Plume Momentum Contacts Sea Bottom
1	17.7	0	32.2	39.7	31.2	No Contact
2	20.6	0	32.2	39.7	34.8	No Contact
3	24.0	0	32.2	39.7	38.4	No Contact
4	17.7	0.325	32.2	20.5	31.2	No Contact
5	20.6	0.325	32.2	20.5	35.1	No Contact
6	24.0	0.325	32.2	20.5	38.0	No Contact

JETLAG predicted the possibility for the discharge plume to come into contact with the bottom but only when considering the edge of the plumes modeled perimeter. Both ambient current scenarios predict the plume to turn and dissipate with both distance and prevailing current conditions, similar to that predicted by VISUAL PLUMES. JETLAG predicted the plume to be momentum driven upon discharge before becoming more buoyant and rising towards the surface. Attainment of the 32.2 °C (90 °F) criterion was predicted at up to 49.4 feet in the horizontal plane from the discharge port and up to 53.3 feet under no influence from ambient currents (Table 2-10). When modeled with a minimal current (0.325 ft/sec), attainment occurred within 28.0 feet in the horizontal plane and up 47.1 feet at depth (Table 2-10).

Table 2-10
Locations at which Temperature Criterion are Met for FSRU Outfall 001 based on the JETLAG Model

Case	Discharge Depth (feet)	Ambient Velocity (ft./sec)	Criteria (32.2 °C/°F) or Bottom Impact Temperature (°C)	Horizontal Distance to Meet Criteria (feet)	Depth to Meet Criteria (feet)	Predicted Discharge Plume Momentum Contacts Sea Bottom
1	17.7	0	32.2	49.4	50.3	Plume periphery
2	20.6	0	32.4	42.5	52.0	Plume periphery
3	24.0	0	32.6	37.4	53.3	Plume periphery
4	17.7	0.325	32.2	28.0	40.3	Plume periphery
5	20.6	0.325	32.2	28.0	43.8	Plume periphery
6	24.0	0.325	32.2	28.0	47.1	Plume periphery

The possibility for the plume to contact the bottom sediments raises the potential for fine grained sediments to be entrained with the influence of the plume and be suspended within the water column. The suspension of such fine grained sediments could result in a temporary increase in total suspended solids (TSS) and localized scouring of the bottom sediments (Appendix 2A).

To prevent macrofouling of the raw water intake systems, chlorine in the form of sodium hypochlorite will be injected into the sea chests (~0.5 ppm solution) servicing the water intake system. The sodium hypochlorite will be produced on the FSRU vessel by an on-board electrolytic sodium hypochlorite generation system that will provide a continuous supply of chlorine for macrofouling control. The chlorine will be allowed to naturally disperse within the water intake systems prior to discharge to levels below NPDES requirements. Residual chlorine as a product of the introduction of sodium hypochlorite will range 0.1 to 0.15 ppm preceding discharge.

Outfall 002 A and B– Auxiliary Seawater Service Cooling

Modeling of the thermal discharge plume associated with the Auxiliary Cooling System was conducted to estimate the change in temperature of seawater at discharge. Similar to that observed at Outfall 001, the modeling effort employed JETLAG as the best model which describes the plume characteristics and an assumed temperature change of 3 °C (37.4 °F) above ambient (Appendix 2A). USEPA guidance (USEPA, 1991) was used to calculate a mixing zone of 57 feet for Outfall 002. JETLAG predicts that the thermal plume to be buoyancy dominated and to rapidly rise and parallel the hull of the FSRU vessel under a no ambient current scenario. Attainment of the 32.2 °C (90 °F) criterion is predicted to be achieved within a horizontal distance of 6.2 feet and a vertical depth of 16.8 to 23.4 feet from the discharge port, both well within the predicted mixing zone (Table 2-11). When applying a minimal ambient current of 0.325 ft/sec, attainment of the 32.2 °C (90 °F) criterion is predicted to be achieved within a horizontal distance of 1.3 to 1.6 feet and a vertical depth of 21.1 to 28.6 feet. The plume is rapidly dissipated beneath the hull of the moored FSRU. Based on JETLAG, the thermal plume Outfall 002 does not impact the bottom.

Table 2-11
Locations at which Temperature Criterion are Met for FSRU Outfall 002 based on the JETLAG Model

Case	Discharge Depth (feet)	Ambient Velocity (ft./sec)	Criterion (32.2°C/90°F) or Bottom Impact Temperature (°C)	Horizontal Distance to Meet Criteria (feet)	Depth to Meet Criteria (feet)	Predicted Discharge Plume Momentum Contacts Sea Bottom
1	20.4	0	32.2	6.2	16.6	No Contact
2	23.9	0	32.2	6.2	20.2	No Contact
3	27.3	0	32.2	6.2	23.4	No Contact
4	20.4	0.325	32.2	1.6	21.1	No Contact
5	23.9	0.325	32.2	1.6	24.7	No Contact
6	27.3	0.325	32.2	1.3	28.6	No Contact

To prevent macrofouling of the raw water intake systems, chlorine in the form of sodium hypochlorite will be injected into the sea chests (~0.5 ppm solution) servicing the water intake system. The sodium hypochlorite will be produced on the FSRU vessel by an on-board electrolytic sodium hypochlorite generation system that will provide a continuous supply of chlorine for macrofouling control. The chlorine will be allowed to naturally disperse within the water intake systems prior to discharge to levels below NPDES requirements. Residual chlorine as a product of the introduction of sodium hypochlorite will range 0.1 to 0.15 ppm preceding discharge.

Outfall 003 A and B– Water Curtain

For safety purposes it is common practice of most LNG vessels to maintain a constant flow of water, referred to as a "water curtain", over the deck and hull of the vessel during LNG transshipment or during the regasification process. In the event of a leak of LNG during these operations, the presence of the water curtain will help protect the metal hull from any potential cracking or stress. Approximately 600,000 gallons of seawater per day will be required to maintain this water curtain during these operations. The seawater used to support this system will enter into the vessel via both high and low starboard and port sea chests. Water will then be pumped onto the deck of the FSRU before being discharged over the sides of the vessel as runoff. The water curtain volume will also be subject to treatment with the sodium hypochlorite for control of marine biofouling within the system. Residual chlorine levels are expected to range 0.1 to 0.15 ppm prior to discharge.

Outfall 004 - Freshwater Generator

Water for the freshwater generator will enter the vessel through both starboard and port high and low sea chests. Non-used seawater within the systems will be discharged with slightly higher salinity content due to consumptive use of freshwater generator. The primary effluent component in this outfall will be brine-enriched seawater. Freshwater consumptive use will include potable supply for ship board use for drinking and sanitary supply. Freshwater supply will also be needed for boiler supply and make up water. Excess volume from the freshwater generator not used for sanitary use or boiler supply will be either stored on the vessel or discharged.

Outfall 005 – Sanitary Treatment System

Operation of the FSRU will also result in galley, hotel services, and sanitary wastes. Water contributing to these wastes will consist of the freshwater generated by the FSRU's on-board desalination system which will service these needs. All black water and gray water wastes will be stored in dedicated septage where it will be pumped off the FSRU and offshore berthing platform by service craft. Assuming a 10 percent usage volume for sanitary system support, approximately 3000 gallons per day of black and gray wastewater will be generated and treated on board the FSRU. Treatment and handling on a daily basis will be handled in compliance with regulations set forth by the 1978 Protocol of the 1973/78 International Convention for the Prevention of Pollution from Ships (MARPOL, Annex IV). Generation of gray/black water will be approximately 1 to 11 m^3/day. Treated effluent will be disinfected to MARPOL, Annex IV standards. Chemical and biological components present within the sanitary effluent that would require monitoring include total coliform bacteria, biological oxygen demand (BOD), ammonia ($N\text{-}NH_3$) and residual chlorine. Disinfection will require dosing with sodium hypochlorite resulting in a 1.0 ppm of residual chlorine prior to discharge.

Outfall 006 - Ballast Water Systems

Ballast water will be discharged in response to on-going FSRU operations and vessel stability needs. Stored ballast water may be subject to treatment with a Ballast Water Treatment System (BWTS) to prevent macrofouling of the ballast tanks. The MGPS treatment of the ballast will be chlorine (i.e., electrolytic sodium hypochlorite generation). Maximum discharge is assumed to not exceed the potential intake volume. Volume of ballast intake and discharge will vary by ballast tank volume and vessel operation status. Total ballast volume will vary with vessel loading and off-loading operations and sea conditions. Depending upon the regasification process demand, flows to ballast tanks could range as high as 10,000 m^3/hr when in use.

Outfall 007 Stormwater

Over deck runoff from precipitation events can be expected to occur intermittently. This runoff will largely be through deck drains and over deck runoff. Deck surface contaminants such as residual oil drips or sheen, heavy metals (associated with rust or metallic particulate matter, dirt may be entrained and mobilized via storm events and potentially discharged to the Caribbean Sea. Barring large spills or releases, such releases are in small quantities and of an intermittent occurrence.

2.3.2.3 Bilge and Blowdown Water Management

Bilge water collected from the FSRU bilge sumps will be managed via pumping off of the FSRU vessel for later treatment and disposal by a certified treatment facility. Surface blow down water from the FSRU boilers and auxillary boiler would also be discharged to the bilge for later disposal and treatment. Residual oil and grease residue will be concentrated, containerized and disposed of to a licensed disposal facility or recycling facility on-shore. USEPA (2003) estimates of oily bilge volume production based on commercial ship statistics identified a range of 1,300 to 5,300 gallons per day depending on ship tonnage (USEPA, 2003). For evaluation purposes, it is assumed that this volume would be similar for the FSRU. This bilge/surface blow down water will contain residual oils and lubricants from leakage and spills, associated boiler chemicals (i.e., pH adjustment compounds and anti-scaling agents), total dissolved solids (mostly rust particles) and heavy metals (mostly associated with particulate material). On board treatment works (i.e., oil water separators) have treatment capacities for 5,000 to 6,400 gallons/day for larger cruise vessels (USEPA, 2003).

When within 12 nm of the nearest land, USCG regulations (33 CFR 151.10 as cited in USEPA (2003)) require ships to conform to the following conditions for the management of bilge discharge into the sea:

1. The oil or oily mixture does not originate from cargo pump room bilges;
2. The oil or oily mixture is not mixed with oil cargo residues;
3. The oil content of the effluent without dilution does not exceed 15 ppm;
4. The ship has in operation oily water separating equipment, bilge monitor, bilge alarm or combination thereof as required by part 155 Subpart B; and
5. The oily water separating equipment is equipped with a 15 mg/L bilge alarm; for U.S. inspected ships, approved under 46 CFR 162.050 and for U.S. uninspected ships and foreign ships, either approved under 46 CFR 162.050 or listed in the current International Maritime Organization (IMO) Marine Environment Protection Committee (MEPC) Circular summary of MARPOL approved equipment.

Oily water that fails to meet the treatment standards must be containerized or diverted for storage for off vessel removal and treatment at an on shore certified qualified treatment facility.

Bottom blow down refers to the removal of accumulated particulates and solids from the bottom of the vessel boilers to facilitate safe boiler operation and efficiencies. Bottom blowdown on the LNG vessel Exemplar was recommended to be conducted on the main boilers every 30 days and every 7 days for the secondary/auxillary boilers (Drew Marine, 2011). This heated mixture containing rust particles, metallic particles, flake scale and heated water contains heavy metals, organic chemicals, dissolved and suspended solids. Bottom blow down approximates 10 percent of the boiler volume (up to 300 gallons/ blow down), occurs infrequently (monthly) and are of short duration (seconds). Discharge temperature and pressure can approach 325 °F and 1,200 pounds per square inch (psi) (USEPA, 1999). The bottom blow down effluent is not proposed for disposal overboard and will be containerized or stored on board the FSRU for off pumping and treatment at an on-shore treatment facility.

2.3.3 LNGC

2.3.3.1 LNGC Water Intake

While unloading LNG at the Offshore GasPort, LNGCs will take in seawater as ballast to maintain stability. Ballast water is taken onto the vessel through its seachests while offloading cargo and it is estimated to take between 25 and 72 hours to complete. Ballast water is typically only discharged during loading operations at an LNG export terminal or during mid-ocean ballast water exchanges during the transit. Therefore no ballast water would be intentionally discharged from LNGCs while at the Offshore GasPort.

LNGCs unloading LNG will also need cooling water for the engines that generate electrical power for the offloading pumps and other onboard systems. The Coast Guard requires that ships' engines are powered up while at dock, therefore there would be cooling water needs during the entire time each LNGC is moored (estimated to be 41 to 88 hours).

The range in size of the LNGCs which may call at the Offshore GasPort is approximately 125,000 m^3 up to 217,000 m^3. These carriers are either diesel engine, or steam-turbine engine driven. The majority of smaller class boats are steam-turbine engines (CH2MHill, 2008). Steam-turbine vessels use more water for cooling purposes than their diesel counter parts.

Estimates for LNGC water consumption are derived from three sources; the Jordan Cove FEIS (FERC 2009), the Broadwater LNG FEIS (FERC 2008), and information provided by Oregon LNG in its application to the FERC (CH2MHill 2008). The Jordan Cove FEIS estimated a range of cooling water intakes, with a low of 1,250 cubic meters per hour (m^3/hr) based on diesel engine vessels using some shore power. Oregon LNG (CH2MHill 2008) estimated 6,300 m^3/hr for cooling water use, while the Broadwater EIS (FERC 2008) used the highest value of 9,800 m^3/hr. The range of potential cooling water and ballast water requirements are shown in Table 2-12. Based on the current vessel characteristics available in the fleet, the higher estimate of water use is most likely to be representative of this Project.

Table 2-12
Estimates of LNGC Water Use and Rate While at the Aguirre Offshore GasPort

Range	Time to Offload (hours)	Total time at AOGP (hours)	Ballast Intake Rate (M^3/hr)[1,2]	Ballast Volume (million gallons)	Cooling Intake Rate (M^3/hr)	Cooling Volume (million gallons)	Total Intake Volume (million gallons)
Low	25	41	2,600	17.2	1,250	13.5	30.7
High	72	88	3,900	74.2	9,800	227.8	302.0

[1] *All ballast intake occurs during offloading.*
[2] *Low value from FERC 2009, high value from FERC 2008*

These LNGCs would take in about 17.2 to 74.2 million gallons of water for ballast while offloading at the Offshore GasPort. Total cooling water volume would range from about 13.5 to 227.8 million gallons while stationed at the Offshore GasPort. Therefore, the total water intake for each LNGC delivery (ballast and cooling water) could range from about 30.7 to 302.0 million gallons.

2.3.3.2 LNGC Discharges

As LNGCs off-load their cargo, they will take on ballast water and withdraw cooling water to maintain stability and operational readiness of the vessel. Ballast water discharge is not anticipated during the off-loading process. Heated discharge associated with the cooling water intake system will be discharged to the adjacent waters of the Offshore GasPort. Surface blowdown and bottom blowdown may also occur as part of normal LNGC operations. However, these would be limited in occurrence as the LNGCs would not conduct routine blow downs while at berth during the transfer of LNG.

The condenser cooling water system will be the dominant discharge associated with the LNGCs. Similar to the FSRU cooling water discharge, the intake system and discharge outlet were considered to be identical to the FSRUs with the exception of a slightly higher maximum volume intake rate and a maximum change in ambient temperature of 3 °C based on off-loading characteristics from the Jordan Cove Project.

Application of JETLAG revealed a confined plume with horizontal and vertical distance to compliance with the temperature criterion at 2.7 feet and < 26.6 feet for a no ambient current scenario (Table 2- 13). Consideration of a minimal ambient current (0.325 ft/sec) results in a horizontal attainment of the temperature criterion at 1.3 feet and a vertical attainment at ≤25.4 feet (Table 2-13). While attainment of the temperature criterion occurs within the near field area of the discharge, the elevated flow rate is projected by the JETLAG model to impact the bottom substrates. This occurrence is projected to occur across all discharge depths and current scenarios (Appendix 2A).

Table 2-13
Locations at Which Temperature Criterion Are Met for LNGC Thermal Discharge Based on the JETLAG Model

Case	Discharge Depth (feet)	Ambient Current Velocity (feet/ Second)	Criteria (32.2°C/90°F) or Bottom Impact Temperature (°C)	Horizontal Distance to Meet Criteria (feet)	Depth to Meet Criteria [1] (feet)	Predicted Discharge Plume Momentum Contacts Sea Bottom
1	17.2	0	32.2	2.7	19.8	Plume periphery
2	20.6	0	32.2	2.7	23.4	Plume periphery
3	24.0	0	32.2	2.7	26.7	Plume periphery
4	17.2	0.325	32.2	1.3	18.5	Plume periphery
5	20.6	0.325	32.2	1.3	22.1	Plume periphery
6	24.0	0.325	32.2	1.3	25.4	Plume periphery

1 *Depth is projected attainment of temperature criterion, plume momentum will impact bottom.*

2.3.4 Offshore Berthing Platform Intake and Discharges

The offshore berthing platform will be manned and will require potable water, fire water and sanitary services. Supply service for potable water will come from the freshwater generation system of the FSRU. Gray and black sanitary water will be collected and stored in temporary holding tanks and serviced via routine off-loading operations. Water demand for the offshore berthing platform form is expected to be minimal relative to the overall daily operations of FSRU. The berthing platform will have a fire water system with a capacity of 232,471 to 237,754 gallons/hr (880 to 900 m3/hr). Source of on demand fire water will be the waters of the Caribbean Sea.

2.4 ENVIRONMENTAL CONSEQUENCES

The impacts associated with withdrawal of seawater and discharge to marine waters would constitute a permitted activity under a surface water National Pollutant Discharge Elimination System (NPDES) program permit. Disturbance and re-suspension of sediments during pipeline construction and placement will be considered a construction impact and a potential environmental consequence.

2.4.1 Construction Related Impacts to Surface Waters

Development of the Project will involve the construction of the offshore berthing platform and mooring pilings for the FSRU and LNGC vessels, and the installation of the submarine pipeline for conveyance of the re-gasified LNG. To support marine construction activities, staging areas and equipment laydown areas will be needed on the mainland of Puerto Rico to supply the installation operations. The Project will involve the temporary disturbance of sediments within Jobos Bay (by the pipeline installation) and the offshore sediments (by the pipeline installation and the the offshore berthing platform).

2.4.1.1 On-Island Equipment Staging and Laydown Areas

Construction activities at the pipeline landfall on plant property will likely involve the disturbance of soils in and around the shoreline area. Soil disturbance and stormwater runoff has the potential to result in sedimentation around the shore area of the landfall location. Erosion and sedimentation controls will be implemented to prevent impacts to surface waters.

2.4.1.2 OffShore Berthing Platform

Construction of the offshore berthing platform will involve the placement and driving of pilings in the sea floor to allow for the securing of the dock and mooring structure for the FSRU and LNGCs. This will result in the temporary disturbance of sediments on the sea floor. Temporary land for construction is estimated at approximately 75 acres and permanent land required is estimated at approximately 22 acres. Construction activities will result in the localized resuspension of sediments into the water column during the construction phase. This resuspension would result in an increase in turbidity in the marine water near the bottom and may result in localized drift of fine grained, suspended sediment in the prevailing water current. Direction of the drift will reflect weather conditions, tidal stages and seasonal currents during construction activities. This potential increase in turbidity would be more concentrated around the area of the platform foot print and would gradually dissipate with distance from the area of disturbance. Benthic substrates on the sea bottom beneath the proposed Offshore GasPort are coarse sands, which are not prone to prolonged resuspension. Given the coarse nature of these substrates, and low sheer potential for resuspension, the disturbance of these sediments would be limited to an area <100 feet from platform pilings.

2.4.1.3 Subsea Pipeline

Installation of the subsea pipeline will consist of using direct placement using direct push methods from the lay construction barge and direct placement of the pipeline in reef areas to minimize impacts to the coral reef. Direct placement and self- burial of portions of the pipeline would only be feasible in areas of low density, fine grained sediments such as those found in areas of Jobos Bay. Total area of temporary land impacts is estimated to be approximately 81 acres. Permanent submerged land impacts are estimated to be 9.7 acres. Jetting of sediments is not proposed. Based upon the benthic mapping, finer grained sediments occur along the pipeline route in portions of Jobos Bay closest to shore. With increasing distance from the mainland, the benthic character takes on a greater percentage of coarser grained sediments and rock/coral outcrops where resuspension of sediments would be less likely to occur. Whitall et al. (2011) classified the sediments of Jobos Bay as being dominated by fine sands, silt and clay. A limited survey of the sediments in the bay confirmed that the sediments are largely composed of 48-93 percent fines (fine sand, silt and clay) (C and C Technologies, 2012). In such areas, the disturbance of the sediments would be confined to the linear area around the pipeline segment being placed. The disturbance and associated effects upon turbidity would be temporary and localized to the pipeline segment being installed. Depending upon local current direction and velocity, localized scouring of sediments around the pipeline may occur. Resuspension and redeposition of these scoured sediments would occur following installation of the pipeline.

Effects on turbidity levels during pipeline installation will vary with degree of disturbance (i.e., partial burial vs. surficial placement), composition of grain sizes present and settling rates following disturbance. Based on available data for the period of record from the National Buoy Center (http://www.ndbc.noaa.gov/), currents along the south shore of Puerto Rico, near the City of Ponce, are primarily tidally induced with a maximum ambient speed of about 0.5 m/sec near the bottom. Storm induced currents occasionally exceeded 0.90 m/s near the bottom. The current velocity of 0.5 m/s corresponds to a bed stress of 0.63 Newtons (N)/m^2 and a shear velocity of 0.025 m/s, using a quadratic resistance coefficient of 0.0025. Within Jobos Bay, ambient currents average 0.1 m/sec and range 0 to 0.26 m/sec (Morelock et al. 1977). The maximum current velocity of 0.26 m/s corresponds to a bed stress of 0.17 N/m^2 and a shear velocity of 0.013 m/s

Critical stresses for mobilization of cohesive behaving mixtures of clay, silt, fine sand and organic matter similar to that in Jobos Bay are on the order of 0.25 to 0.5 Newtons N/m^2, The critcal stress to mobilize fine to medium 250 micron sand grains is approximate 0.25 N/m^2, while coarser 1000 micron (1 mm) sand has a critical stress of approximately 0.4 N/m^2. Vertical settling rates for any fine suspended substrates range from approximately 5 meters/day for clay and very fine silt to over 5000 m/day for coarse sand. For the range of current velocities and corresponding bed stresses in the study area, resuspended clay and silt would be transported in suspension while resuspended sand would be transported as bed load (i.e., surficial material sheared from the bottom substrate). Under tidal conditions, little net transport of either suspended or bed load material will occur due to settling at slack tide and alternating bi-directional transport with successive flood and ebb flows. Therefore, increases in turbidity are expected to be of local origin to the pipeline work and of short duration relative to the construction period. The finer substates associated with Jobos Bay would have a higher potential for resuspension from pipeline disturbance. The rapid settling rates associated with various particle sizes (5 m/day for silt and clay up to 5,000 m/day for coarse sand) and low current speeds in the bay suggest that resuspended sediments would not persist in the water column for an extended period of time.

Additionally, the reversing nature of the tide would result in little net transport of sediment from around the vicinity of the pipe itself. Therefore, any suspended sediments will remain proximal to the pipeline. Depending upon local current direction and velocity, localized mobilization from scouring and redeposition of sediments around the pipeline may occur though the reversal of an ebbing and flooding tide. Tidal flux will offset any scouring of benthic material from around the pipeline and will be limited to normal bed load material mobilization. Pipe line construction will likely result in some localized resuspension with the resuspended material quickly equilibrated as bed load due to the tidal nature of the environment. Therefore no significant impact from sediment scouring is anticipated.

The low concentrations of chemical constituents detected in the sediments of Jobos Bay suggest that these concentrations are not generally problematic with regard to negative effects on infaunal benthic communities and should not represent a significant risk to pelagic organisms in the event of resuspension. Most of the detected constituents in the sediments of the bay remained below the effects range low (ERL) screening value indicating that these detected concentrations do not represent a significant risk to marine life. The concentrations observed within the area of the bay were comparable to concentrations observed in other marine environments of Puerto Rico (Whitall et al. 2011). Minor exceedances of the ERL were noted for DDT, arsenic, copper and nickel at maximum detected concentrations. Exceedance of the ERL is not considered a definitive basis for negative effects but only as an inferential consideration for potential effects when considered in the context of background concentrations. Whitall et al. (2011) compared the detected concentrations of these constituents to other areas of Puerto Rico and concluded that these concentrations were well within range of other marine waters surrounding Puerto Rico. The comparative nature of the sediment quality to other areas of Puerto Rico indicated that no excess contamination risk existed in event of resuspension and redeposition.

2.4.2 Withdrawal Related Impacts to Surface Waters

The proposed Project will utilize raw seawater for operational and maintenance support systems and fire suppression. This use will require the withdrawal of seawater via the FSRU's sea chests and the LNGC intake systems.

2.4.2.1 Construction of Port and Pipeline Installation

Hydrostatic testing of the pipeline will be performed using seawater. The filter screen size will be 100 micron. The intake rate for the water volume will be dependent upon the speed of the pipe pig used in the test, which will be somewhere between 0.5 to 0.92 meters per second (m/sec) (1.5 to 3 fps). Based on volume of the pipeline, about 240,000 gallons will be required to fill and test the pipeline; however, the actual amount of water needed to complete the testing will depend on the number of hydrostatic tests required. Assuming one to three tests will be required to complete hydrostatic testing, testing will require between 240,000 and 720,000 gallons of water. All raw seawater used in hydrostatic testing of the pipeline will be discharged near the shore approach in Jobos Bay following successful testing. No consumptive losses are expected as part of this withdrawal. AOGP will obtain all required permits and authorizations to conduct the hydrostatic tests.

2.4.2.2 Gasport Operations

Offshore Berthing Platform

The offshore berthing platform will be serviced via the FSRU systems. No individual intake system will be used to operate the offshore berthing platform.

Pipeline

With the exception of the hydrostatic tests during the construction phase of the project, water withdrawal for pipeline operation will not be required.

FSRU

The FSRU will withdraw up to 56 MGD during operation. This volume will be withdrawn from the adjacent marine environment. The withdrawal volume will be subject to treatment with a biocide to minimize fouling of the water intake system. Approximately 84 percent of the 56 MGD withdrawal volume will be for cooling water for the FSRU. Consumptive losses of withdrawn water are predicted to be only 0.03 MGD through the freshwater generator for potable and sanitary supplies. All remaining water is expected to be discharged back to the surrounding marine waters.

LNGC

During off-loading operations, the LNGC will operate its water intake systems to supply cooling water and service water supplies to maintain operating systems in support of vessel operations. Ballast water will be taken on to compensate for changes in the LNG mass on board the LNGC. Ballast will be used to maintain vessel stability and will be retained once the offloading of the LNG is completed. The ballast volume to be retained will vary with vessel size. Consumptive losses by on board water usage (via the freshwater generator) are expected to be minimal during off- loading periods.

2.4.3 Discharges to Surface Waters

Discharge related impacts to the marine waters will be related to in-situ water disturbance during construction activities, FSRU operations for consumptive use, macrofouling control treatments, condenser cooling and LNGC operations during LNG transfers.

2.4.3.1 Construction Related Discharges

In addition to hydrostatic testing, construction of the subsea pipeline will require the use of multiple support vessels including a lay barge, pipe boat vessel, dive support vessel, crew boat, support tug and a variety of smaller support vessels. The larger vessels will require ballast (for larger craft) and cooling water during their use, thereby increasing localized releases to the local waters. These discharges are considered temporary in effect to the local area for only the duration of construction activities.

2.4.3.2 FSRU and LNGC Discharges

The main water discharge during Project operation will be heated condenser cooling water from the FSRU. The LNGC discharge will be of similar volume but with a smaller temperature rise above ambient sea temperature. Potential impacts from specific discharge points are described below.

Outfall 001A and B – Main Condenser Cooling Water

Based upon a similar FSRU vessel in operation, change in temperature (delta-t) in the condenser cooling system does not exceed 12 °C (53.6 °F) during normal operation (Tetra Tech, Inc., 2012). This temperature rise is assumed to be representative of that of the FSRU for the Offshore GasPort. Based on a discharge outlet size of 55 inches for Outfall 001, a mixing zone length of 201 feet was predicted using EPA methodology (EPA, 1991). The PREQB has set a narrative water quality standard for no added heat resulting in a temperature above 32.2 °C (90 °F) (PREQB, 2010). A maximum ambient water temperature of 29.2 °C (84.6 °F) for local waters and a 12 °C temperature rise puts the maximized discharge temperature at 41.2 °C (106.2 °F) upon discharge from the FSRU. This discharge is 9 °C above the PREQB temperature criterion for a maximum temperature value. Thermal plume modeling analysis predicted compliance with the 32.2 °C (90 °F) criterion at a horizontal distance of 20 to 47 feet and a depth of 31 to 47 feet in the water column under minimal current conditions (Appendix 2A). Thermal compliance with the PREQB narrative criteria of 32.2 °C (90 °F) will be attained within the predicted mixing zone of the discharge for Outfall 001 of the FSRU. This point of compliance is predicted to be ~50 feet within the horizontal and vertical plains of the Outfall 001 discharge outlet.

Modeling of the plume reveals the discharge to be momentum driven immediately following its release from the outfall with the potential to impact the sea floor. This assumes a maximized flow scenario for the FSRU and minimal influence from ambient currents in the water column to deflect the plume. A minor component of the plume edge is modeled to impact the bottom before becoming more buoyant and rising in the water column towards the surface. The edge of the plume may contact the bottom resulting in the suspension and redeposition of fine grained sediment particles. The disturbance of the sediments is expected to be limited to the initial start-up period of the FSRU operation. This bottom impact could result in the temporary suspension of fine grained sediments in the water column. However, benthic surveys have revealed a coarse sand and shell fragment bottom in the offshore waters where the Offshore GasPort is proposed. Based on the projected plume velocities and grain size stress coefficients from the literature, the coarse sand and shell fragment substrates would be less prone to suspension in the water column than finer grained sediment such as silts and clays.

Biocide enrichment to prevent macrofouling of the raw water intake systems may include the injection of electrolytically generated sodium hypochlorite. Sodium hypochlorite will be injected into the water intake system at the sea chests and would disperse within the water intake system. Residual chlorine from the injection process may be discharged as part of the cooling effluent from Outfall 001 and residual chlorine levels at the discharge are expected to range 0.1 to 0.15 ppm within the water intake system. Currently there is no PREQB water quality standard for residual chlorine for SB/SC waters but USEPA recommended water quality criteria are 0.013 ppm for continuous maximum concentration (CMC) and 0.007 ppm for continuous chronic concentration (CCC) in marine waters (USEPA, 1986). The in-system residual chlorine levels would exceed the USEPA CMC and CCC standards for marine waters. The residual chlorine levels are expected to be further diminished within the mixing zone of the outfall. The presence of residual chlorine in the cooling effluent outfall will be included in AOGP's NPDES operating permit.

Outfall 002 A and B– Auxiliary Seawater Service Cooling Water

Based upon a similar FSRU vessel in operation, the delta-t in the auxiliary condenser cooling system is approximately 3.0 °C above ambient water temperature. The net increase in the thermal loading is expected to be local in effect on water quality. Discharge from this system is predicted to mix rapidly and return to near ambient sea surface temperature. While localized rises in ambient temperature may be observed to exceed the PREQB standard of no addition of heat resulting in water temperatures above 32.2 °C (90.0 °F), these increases were modeled to be limited to areas immediately surrounding the discharge port. Thermal compliance with the PREQB narrative criteria of 32.2 °C (90 °F) will be attained within the predicted mixing zone of the discharge for Outfall 002 of the FSRU. This point of compliance is predicted to be ~6 feet within the horizontal and ~30 feet within the vertical plain of the Outfall 002 discharge port. Sodium hypochlorite will be injected into the water intake system at the sea chests and would disperse within the water intake system. Residual chlorine from the injection process may be discharged as part of the cooling effluent from Outfall 002 and residual chlorine levels within the intake system are expected to range 0.1 to 0.15 ppm. Currently there is no PREQB water quality standard for residual chlorine for SB/SC waters but USEPA recommended water quality criteria are 0.013 ppm for continuous maximum concentration (CMC) and 0.007 ppm for continuous chronic concentration (CCC) in marine waters (http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm). The in pipe residual chlorine levels would exceed the USEPA CMC and CCC standards for marine waters. The residual chlorine levels are expected to be further diminished upon discharge from the outfall. The presence of residual chlorine in the cooling effluent outfall will be included in AOGP's NPDES operating permit.

Outfall 003 A and B- Water Curtain

For safety purposes the FSRU will maintain a constant flow of water, referred to as a "water curtain", over the deck and hull of the vessel during the regasification process. In the event of a leak of LNG during regasification, the presence of the water curtain will help protect the metal hull from any potential cracking or stress. The seawater used to support this system will enter into the vessel via both high and low starboard and port sea chests. Water will then be pumped onto the deck of the EBRV at a flow rate of 0.6 MGD and discharged over the sides of the vessel. The water used for the water curtain will undergo no temperature change and no chemicals will be added to the water as it circulates through the system (Northeast Gateway NPDES Fact Sheet http://www.epa.gov/region1/npdes/offshorelng/pdfs/attachments/draftma0040266fs.pdf). The water used for the water curtain will undergo no temperature change. Sodium hypochlorite will be introduced into the sea chests and will be present in the water curtain during operation and discharge. Residual chlorine within the water curtain system is expected to range 0.1 to 0.15 ppm. in the water curtain discharge. Currently there is no PREQB water quality standard for residual chlorine for SB/SC waters but USEPA recommended water quality criteria are 0.013 ppm for continuous maximum concentration (CMC) and 0.007 ppm for continuous chronic concentration (CCC) in marine waters (http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm). The in system residual chlorine levels would exceed the USEPA CMC and CCC standards for marine waters. The residual chlorine levels are expected to be further diminished within the mixing zone of the outfall. The presence of residual chlorine in the cooling effluent outfall will be included in AOGP's NPDES operating permit.

Outfall 004A and B - Freshwater Generator

Of the 0.3 MGD of intake for the freshwater generator, approximately 0.03 MGD will be consumed to support on vessel needs for potable and sanitary supplies and as feed water for main and auxillary boilers. The remaining 0.27 MGD will be discharged as brine water. The brine water discharge will be of slightly higher salinity content than the surrounding surface waters. Source water for the freshwater generator will be seawater subject to the treatment with sodium hypochlorite. It is unclear if residual chlorine subjected to desalinization would be present following treatment. Anticipated brine from the desalinization process could consist of multiple salts of magnesium and calcium. Salinity of the discharge is not expected to be much higher than ambient sea water.

Outfall 005 - Hoteling and Sanitary Treatment System

Wastewater (referred to as gray and black water) will be managed on a daily basis in compliance with regulations set forth by the 1978 Protocol of the 1973/78 International Convention for the Prevention of Pollution from Ships (MARPOL, Annex IV). MARPOL has established that the discharge of sewage into the sea will be prohibited, except when the ship has in operation an approved sewage treatment plant or is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; or is discharging sewage which is not comminuted or disinfected at a distance of more than 12 nautical miles from the nearest land. Therefore the FSRU will be required to have a marine sanitation device (MSD) to treat and disinfect sewerage or be provided services for the storage and pump off of black and gray water for treatment at a land based facility. Treatment standards for the MSD will be accordance with the following goals prior to discharge: total coliform count <200 per 100 mL, biological oxygen demand (BOD) <50.0 ppm and suspended solids <50 ppm. The PREQB and USEPA recommend a standard of total fecal coliform of a geometric mean of a series of representative samples (at least five samples) of the waters taken sequentially to not exceed 200 colonies/100 ml, and not more than 20 percent of the samples shall exceed 400 colonies/100 ml for SB waters (PREQB, 2010). The PREQB identifies BOD standards with a narrative statement of a compliance point to be determined on a case by case basis depending on the assimilative capacity of the receiving water body. Such determination will be performed to assure compliance with the dissolved oxygen standard applicable to the receiving water body (PREQB, 2010). Similarly, the PREQB has a narrative water quality statement for suspended solids as wastewater sources not causing deposition in or be eleterious to the existing or designated uses of the receiving water body. USEPA currently does not have numerical criteria for marine waters. Residual chlorine from sodium hypochlorite injection for disinfection may range as high as 1.0 ppm within the treated sanitary system. This exceeds the USEPA recommended water quality criteria of 0.013 ppm for continuous maximum concentration (CMC) and 0.007 ppm for continuous chronic concentration (CCC) in marine waters (USEPA, 1986). However, residual chlorine levels can be controlled within the MSD for selecting an appropriate residual chlorine concentration prior to discharge.

Outfall 006 A amd B Ballast Water Fluxes

FSRU vessel operations will require ballast functions to maintain vessel stability during the LNG off - loading process. The LNGC will take in ballast water during LNG off- loading operations. Volumes will vary by vessel size and cargo capacity. Volume fluxes of up to 1.9 mgd may be taken up or discharged from the ballast system of the moored FSRU to accommodate vessel stability and operation. The FSRU will take in ballast water as LNG supply is vaporized and delivered to PREPA's Aguirre Plant and discharge ballast water as new LNG supply is transferred onboard from the LNGC. Ballast systems may be subjected to intermittent treatment by a MGPS to minimize the potential for macrofouling of the on-board ballast system and prevent transport of invasive species. Treatment will occur within the ballast tanks. Discharges containing biocide from the ballast tanks will be neutralized to limit introduction of chemical treatments to local waters. This discharge will be compliant with the NPDES permit for the project. Other than application of the biocide, no other treatment or discharge will occur within the ballast water management system. Sodium hypochlorite will be introduced into the sea chests and will be present in the water curtain during operation and discharge. Residual chlorine within the water curtain system is expected to range 0.1 to 0.15 ppm. Currently there is no PREQB water quality standard for residual chlorine for SB/SC waters but USEPA recommended water quality criteria are 0.013 ppm for continuous maximum concentration (CMC) and 0.007 ppm for continuous chronic concentration (CCC) in marine waters (http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm). The in system residual chlorine levels would exceed the USEPA CMC and CCC standards for marine waters. The residual chlorine levels are expected to be further diminished upon discharge within the mixing zone of the outfall. The presence of residual chlorine in the cooling effluent outfall will be included in AOGP's NPDES operating permit.

Outfall 007 Stormwater

The FSRU will be berthed at the Gasport for LNG regasification for the project duration up to a period of five years between service periods. The vessel will be subject to routine precipitation events which will result in sheet flow runoff from the vessel surfaces and decks. Routine operations may result in minor leakage of lubricants and grease from on board equipment and particulate matter (i.e., dirt or dust) may also accumulate on these surfaces. During rain events these materials may be entrained in over deck runoff and released to the waters of the Caribbean Sea intermittently and in small quantities. Such releases are difficult to quantify for a moored vessel. While no single outfall is dedicated to such events some degree of discharge can be expected. To the extent practical through the use of equipment drip vats, good management practices for minimizing releases (i.e., storm water management plan) and the use of oil absorbent material around collection drains such releases will be minimized.

2.4.3.3 Bilge and Boiler Blowdown Management

FSRU bilge and boiler water blown down effluents will be managed via on vessel storage and pump out. Pumped out effluents from these sources will be transported to an on shore treatment facility and will not discharged to adjoining waters. LNGCs will not discharge bilge or blow down effluents while docked at the Gasport Facility for off-loading.

2.4.4 Groundwater and Potable Water Resource Impacts

2.4.4.1 Groundwater Resources

The Project will not affect groundwater resources associated with the Jobos Bay area. Therefore no environmental consequences are expected to occur to this resource.

2.4.4.2 Municipal Water Supplies

The Project will not affect municipal water supplies and no environmental consequences to municipal water supplies are expected.

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RESOURCE REPORT 2

MAPS AND FIGURES

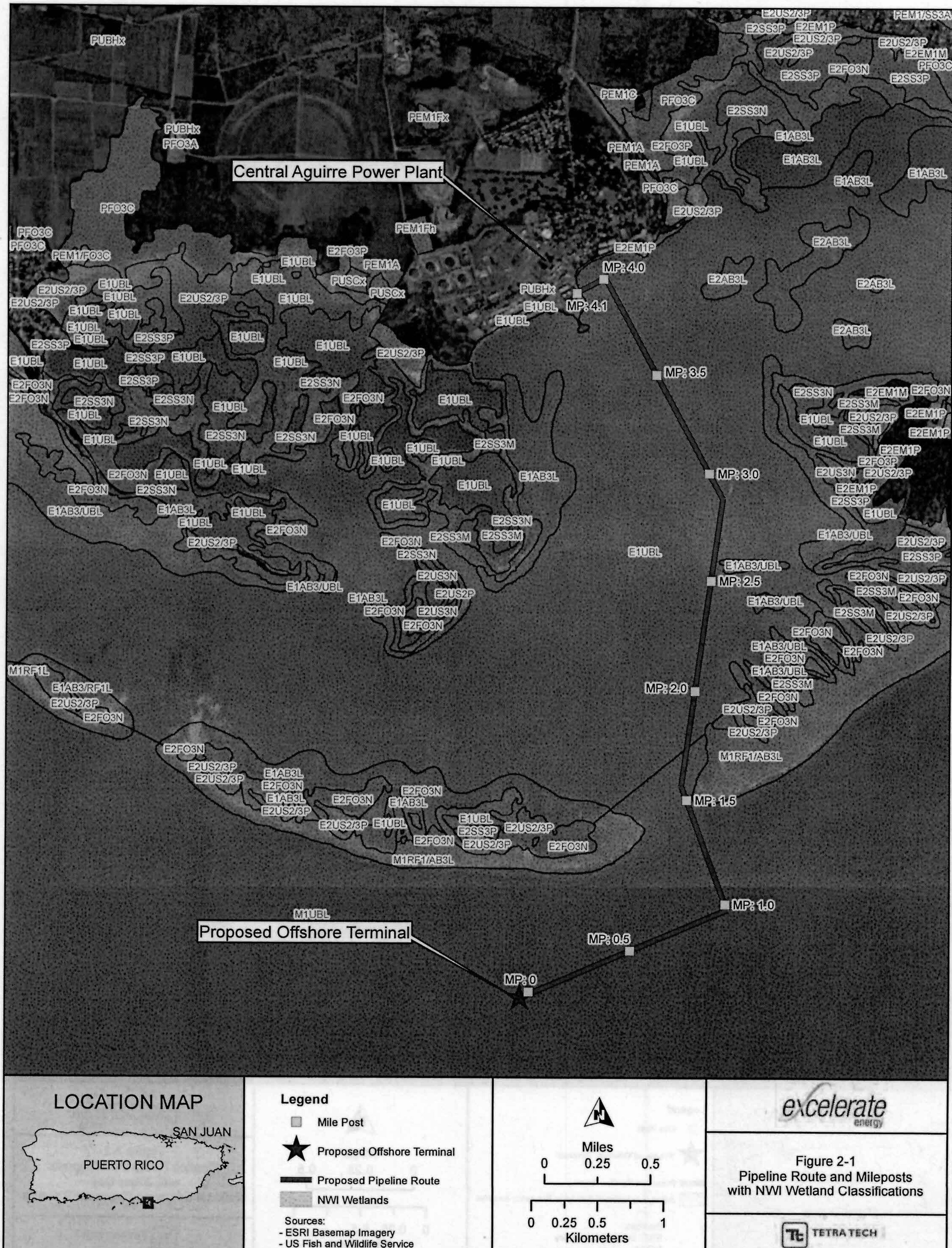

Figure 2-1
Pipeline Route and Mileposts
with NWI Wetland Classifications

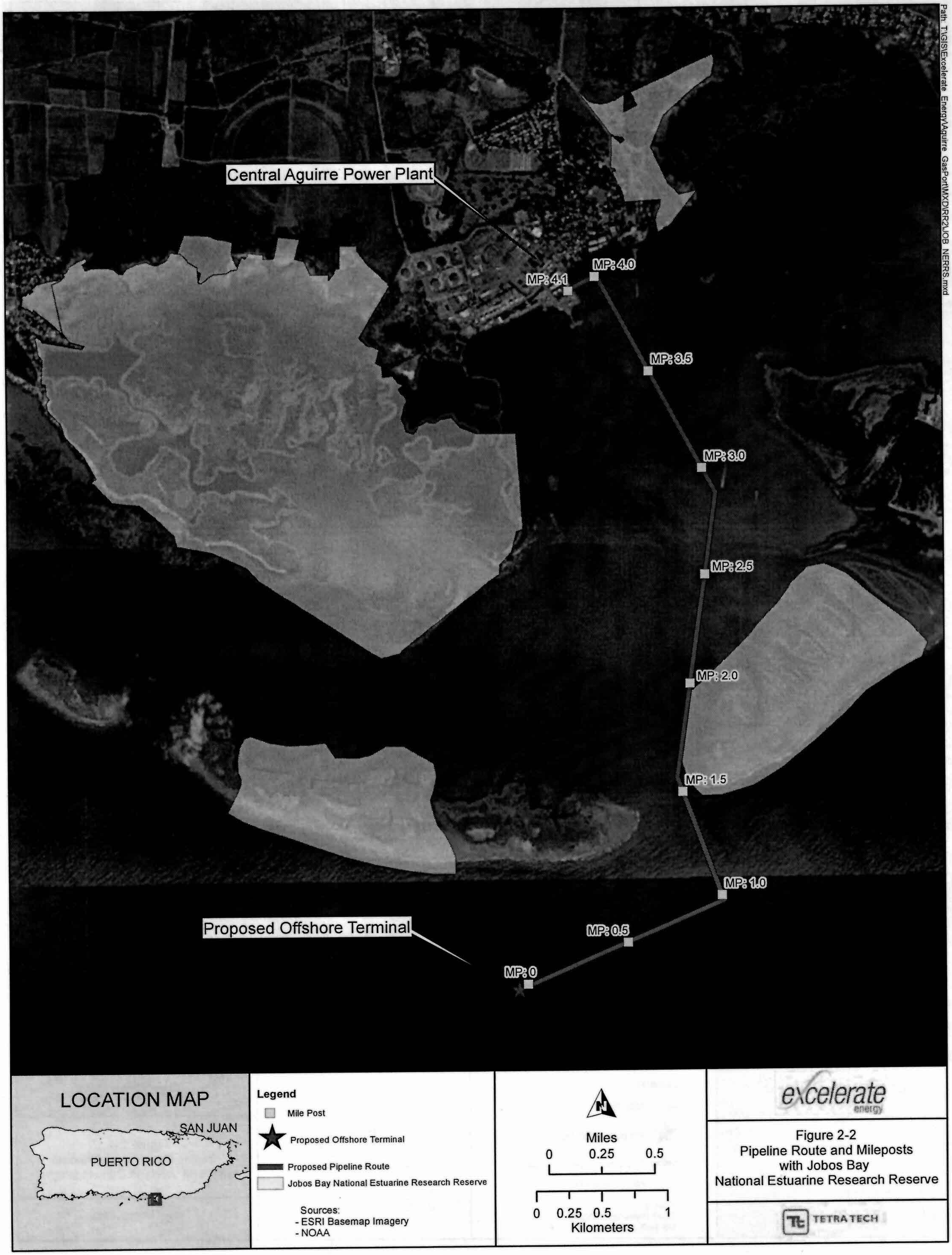

Figure 2-2
Pipeline Route and Mileposts
with Jobos Bay
National Estuarine Research Reserve

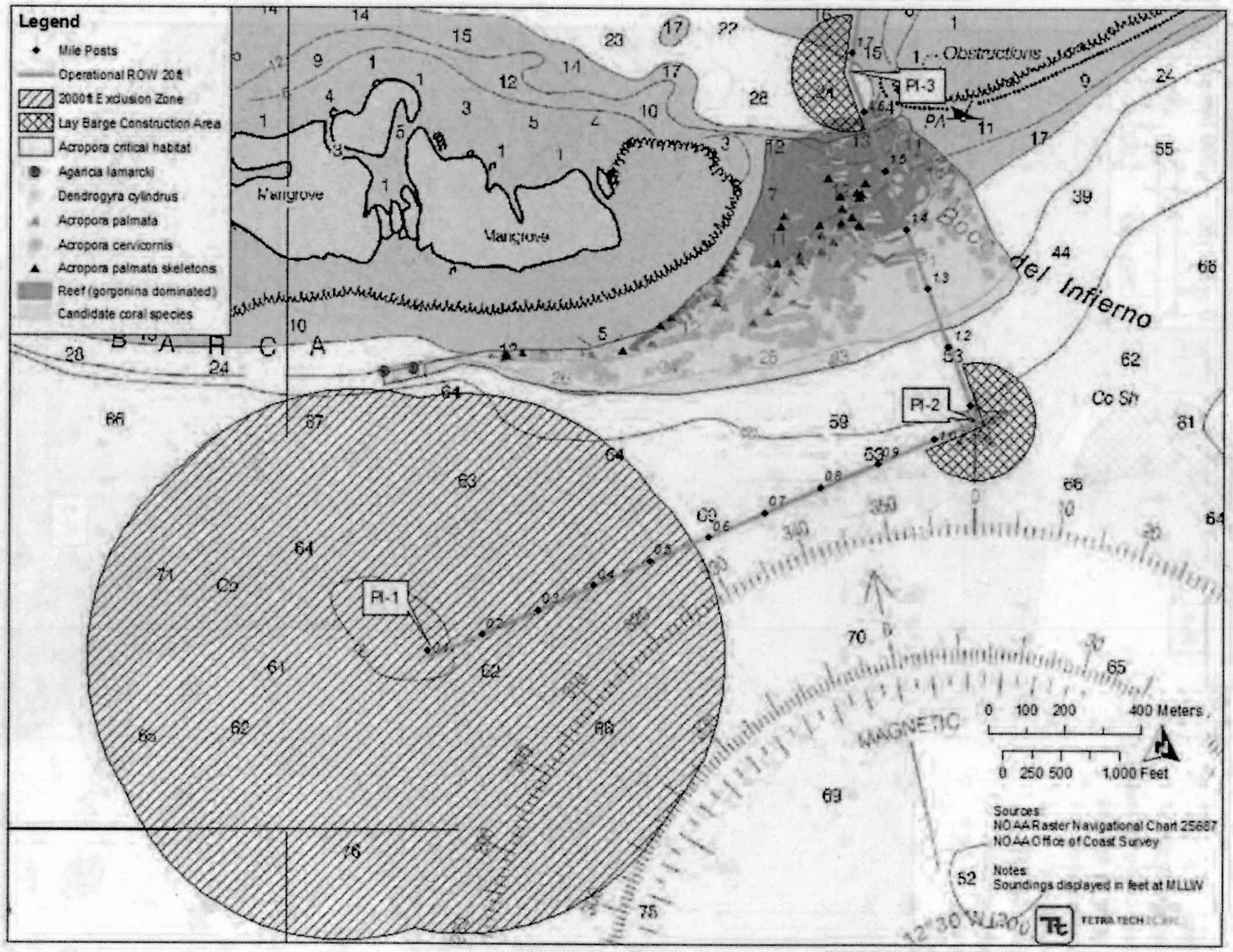

Figure 2-3: Coral Communities within the Pipeline Right-of-Way and Construction Zones, Mile Post 0.0-1.6

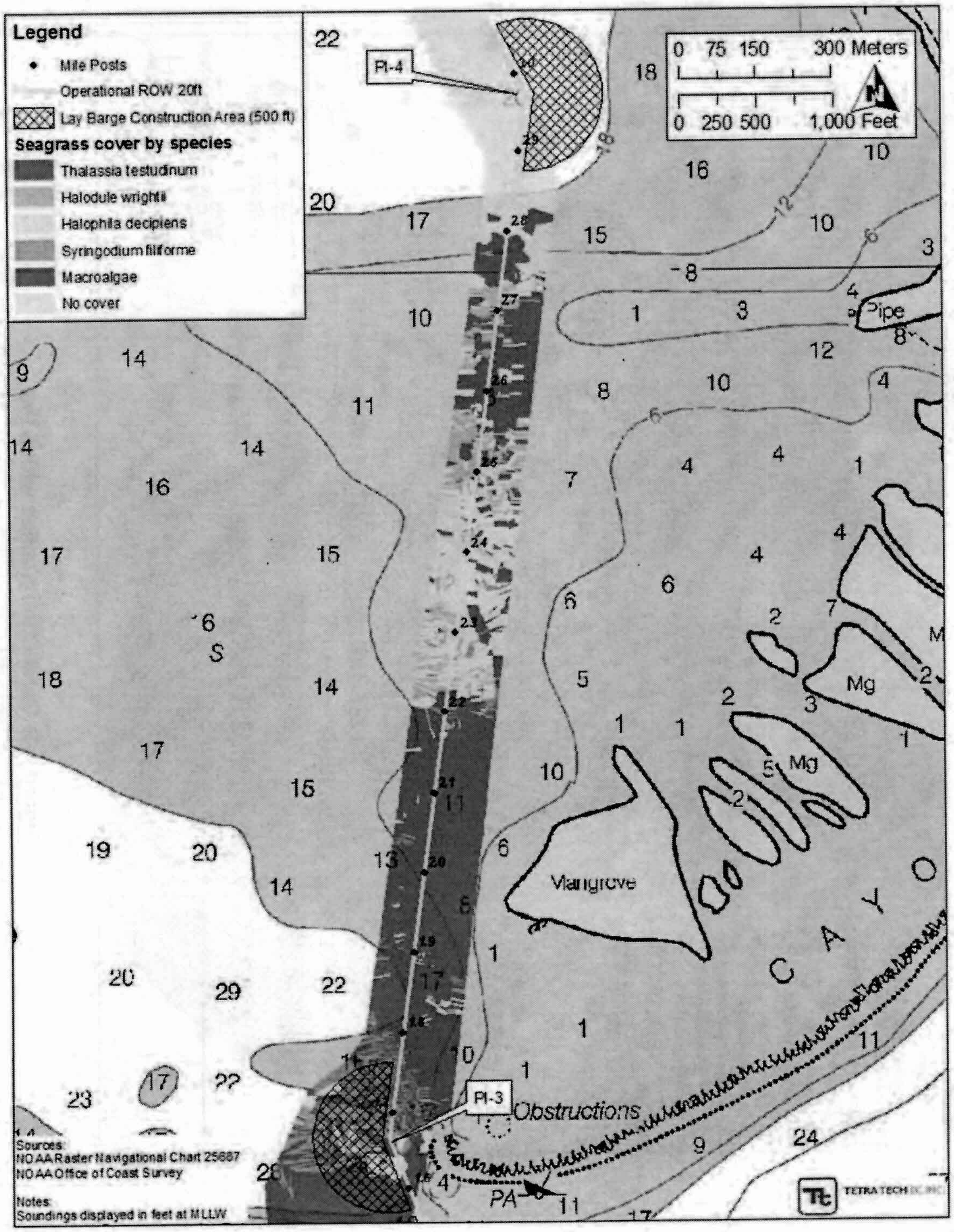

Figure 2-4: Seagrass Communities within the Inshore Pipeline Right-of-Way and Construction Zones, Mile Post 1.6-3.0

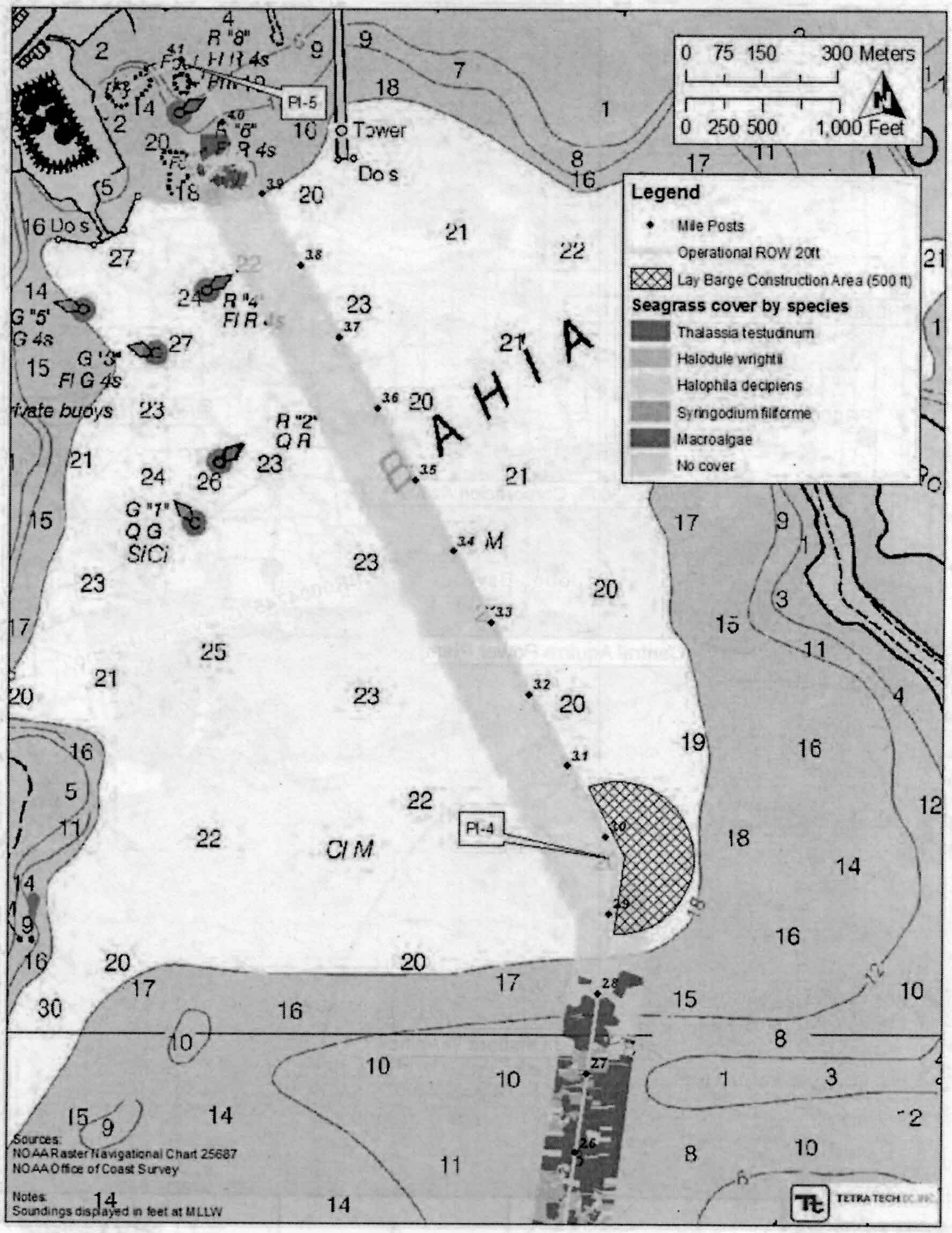

Figure 2-5: Seagrass and Non-Vegetated Covertypes within the Inshore Pipeline Right-of-Way and Construction Zones, Mile Post 2.6-4.1

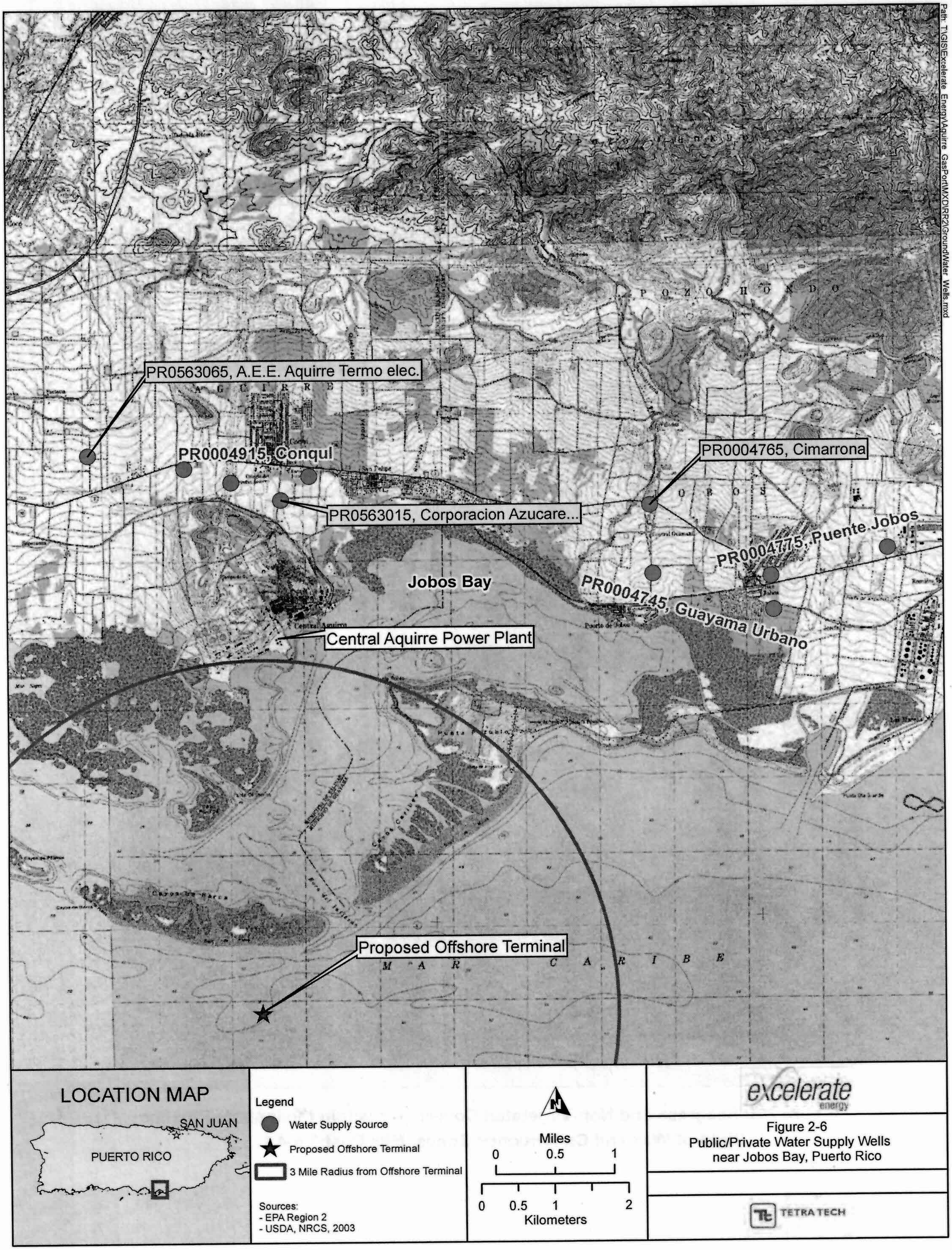

Figure 2-6
Public/Private Water Supply Wells near Jobos Bay, Puerto Rico

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RESOURCE REPORT 2

APPENDIX 2A

Thermal Plume Modeling Assessment

Prepared by Tetra Tech, Inc.

EXCELERATE ENERGY

Aguirre Offshore GasPort Project

Thermal Plume Modeling Assessment - Water Use and Quality

July 11, 2012

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1.0 Introduction

The following memorandum documents the results of the thermal discharge modeling for the Aguirre Offshore GasPort Project. This evaluation documents the modeling of the thermal discharges from a Floating Storage and Regasification Unit (FSRU) and a Liquidified Natural Gas Carrier (LNGC) at the Aguirre Offshore GasPort project off the southern coast of Puerto Rico, offshore from the inlet to Jobos Bay. Separate thermal discharges from the fixed FSRU, a permanently moored EBRV continuously providing natural gas to the Aguirre Power Plant, and an intermittently moored LNGC, transferring liquefied natural gas (LNG) to the FSRU will be considered.

Discharge and Ambient Characteristics

Heated discharge properties and ambient conditions were assembled for FSRU Outfalls 001 and 002 and are summarized in Table 1. Flow rates, port diameters, orientations, and depths below the surface were taken for vessel specification. It is assumed that the discharges exist normally beneath the vessel hull and due to the length of the vessels, ambient currents are parallel to the vessel. The temperature rise of 12 ^{o}C for the FSRU Outfalls was based on operating records and renewal of the Northeast Gateway National Pollutant Discharge Elimination System (NPDES) Permit. Less information is available for the LNGC discharge. Provided data include the 2.72 cm/sec discharge and the 3 ^{o}C temperature rises based on data from the Jordan Cove FEIS. Other port data were taken as the same as the FSRU Outfall 001. Ambient temperature data were taken. Other port data were taken as the same as the FSRU Outfall 001. Ambient temperature data were taken as the maximum mean monthly average surface temperature form the Metocean Study (Forristall, 2010). Mean lower low water (MLLW) depths were taken from the NOAA chart with a depth of approximately 18.3 meters. NOAA Etopo01 (http://www.ngdc.noaa.gov/mgg/global/global.html) depths for the region were slightly deeper with a value of 20.95 meters. Generally shallow depths are more critical with respect to plume mixing so a value of 19.2 meters (applying 0.67 chart + 0.33 etopo values for estimating ambient depth to bottom) was used. Detailed bathymetry data collected for the Aguirre Gasport Project confirm 18.8 to 19.1 meter depth intervals at the proposed location. The location of the vessel discharge port for Outfall 001 and 002 was modeled using the minimum and maximum depth ranges presented in Table 1. Discharge port depth for the LNGC was assumed to be similar to that for the FSRU (Table 1).

High current velocities tend to result in rapid mixing and high dilution rates making low current speeds more critical for plume temperature dissipation. For this study, two cases were considered, no ambient currents (0 m/sec) and a low ambient current speed of 0.10 meter/sec parallel to the vessel hull and normal to the discharge port orientation. Tidal current data on the southern coast of Puerto Rico is sparse with Morelock, et al (undated) estimating maximum tidal current speeds of 0.1 to 0.2 meters per second. Mean current are of a similar magnitude. Thus the two current cases considered in this analysis are very conservative.

Puerto Rico has a maximum temperature criteria of 32.2^{o} C (90^{o} F) which with is used to define impacted areas for the plume temperature field and the possible need for a mixing zone. The US EPA Technical Guidance (US EPA, 1991) defines a number of approaches for defining mixing zones based on discharge characteristic. The approach most appropriate for this situation is defining the mixing zone as a distance equal to 50 times the discharge length scale in all directions. The resulting mixing zone lengths are 62 and 17.5 meters (201 and 57 feet) for

Outfalls 001 and 002 respectively for the FSRU and 62 meters for the LNGC main condenser discharge,

2.0 Model Selection and Approach

A number of models are available for thermal jet-plume evaluation including CORMIX (Doneker and Jirka, 2007), VISUAL PLUMES (VP) (Frick, et al., 2003), and JETLAG/VISIJET (JETLAG) (Lee and Cheung, 1990: Lee and Chu, 2003; Choi and Lee, 2007) which model single and multiport discharges into a non-evolving ambient environment. For complex discharge situations where multiple, potentially interacting discharges, or the need to address potential recirculation into intakes, or the presence of evolving ambient conditions, the Environmental Fluid Dynamics Code (EFDC) model (http://www.epa.gov/ceampubl/swater/efdc/index.html), is recommended. The EFDC model is three-dimensional hydrodynamic and transport model which includes an embedded version of JETLAG making it possible to simulate multiple intakes and thermal discharges in high complex and evolving ambient environments.

All of the four proposed models are recognized and accepted by regulatory agencies. CORMIX and VISUAL PLUMES were developed by US EPA and are widely used for mixing zone studies. JETLAG is widely used internally and has been accepted for mixing zone studies in US EPA Region 4 (Tetra Tech, 2008a, 2008b, 2010). The modeling approach used in this study is to use all three models, CORMIX, VISUAL PLUMES and JETLAG to simulate the discharge plume primarily since CORMIX fails to provide complex results. The relatively short trajectories to the location meeting the 32.2° C temperature criteria indicate that recirculation into the intake and tidal double dosing are not important and that an embedded buoyant jet in a larger scale EFDC model is not necessary.

Table 1. FSRU and LNGC Discharge Properties

Vessel Discharge Property	FSRU Discharge 1 Outfall 001	FSRU Discharge 2 Outfall 002	LNGC Thermal Discharge
Flow Rate, (cubic meters per second)	2.06	0.26	2.72
Discharge Port Diameter, (meters)	1.4	0.4	1.4
Port Area, (square meters)	1.54	0.126	1.54
Length Scale (square root of area), (meters)	1.24	0.35	1.24
Port Discharge Velocity, (meters/se)	1.34	2.06	1.34
Discharge Angle from Horizontal, (degrees)	-45	-45	-45
Discharge Angle form Ambient Flow, (degrees)	90	90	90
Discharge Depth Range, (meters)	5.3 – 7.4	6.3 -8.4	5.3 – 7.4
Discharge Temperature Above Ambient (° C)	12	12	3
Maximum Ambient Temperature, (° C)	29.6	29.6	29.6
Water Depth, (meters)	19.2	19.2	19.2
Mean Tidal or Ambient Current, (meters/sec)	0.10	0.10	0.10
Not to Exceed Temperature Criteria, (° C)	32.2	32.2	32.2
EPA Guidance Mixing Zone (50 x length scale), (meters)	62	17.5	62

3.0 Model Results for FSRU Outfall 001

Model results for FSRU Outfall 001 are presented in Tables 2 through 4. Results for CORMIX are shown in Table 2. CORMIX predicts that the plume impacts the bottom but provides no vertical trajectory prior to impact. Once the plume impacts the bottom, the plume is modeled as a bottom attached half plume with dilution output as a function of distance from the discharge provided. For the case based on no current and discharge depths below the surface of 5.3 and 6.35 meters, the 32.2 ^{o} C, temperature criteria is met at 42 meters, which is within the proposed 62 meter mixing zone for Outfall 001. For the 0.10 meter/second current case, the distance to meeting the temperature criteria is reduced to 28 meters. For the 7.4 meter discharge depth CORMIX fails to provide solutions. Given the unsatisfactory performance of CORMIX, this model was not considered appropriate for the set of parameters applied and shallow water depths present. Therefore, additional simulations were conducted with VISUAL PLUMES and JETLAG to assess the thermal discharge

Table 3 shows results for the simulation using the VISUAL UM3 module for FSRU Outfall 001. The model behaves quite differently than CORMIX and does not impact the bottom but approaches the bottom and then rises towards the surface. For the three port depth cases, the no ambient current scenario identifies the temperature criterion to be met at horizontal distances of 12.2 and 13.4 meters. Depths to meet the criteria start at 9.6 meter and decrease by approximately a meter for the successive depths below the surface. With a 0.1 meter/sec ambient velocity, the horizontal distance is reduced 6.3 meters due to an increase in ambient water entrainment caused by the modeled current. Depths to meet the criteria are similar to the no current case with depths to attainment in the range of 9.6 to 11.7 meters (Table 3).

Results for the application of JETLAG to FSRU Outfall 001 are presented in Table 4. The JETLAG model predicts bottom impact of the plume based on the edge of the plume intersecting the bottom. However if bottom impact was based on plume center line impacting the bottom there would be not bottom impact and the plume behavior would be similar to the falling and rising trajectory of VISUAL PLUMES whose impact criteria were not available. For the no ambient current case, JETLAG predicts somewhat larger horizontal distances, (15.3 meters or less), to meeting the temperature criteria. For the 6.35 and 7.4 meter port discharge depths, temperature at bottom impact is slightly over the criteria, but the criteria should be subsequently reached in less than one meter due additional mixing in the bottom boundary layer. Depths at which the temperature criterion are met are also larger than those predicted by VISUAL PLUMES. For the cases with ambient current horizontal distance to meet the temperature criteria are 8.6 meters, again somewhat larger than the VISUAL PLUMES predictions. Depths at which the criteria are met range from 12.4 to 14.5 meters.

From these results it is seen that the VISUAL PLUMES and JETLAG models produce consistent results with JETLAG being slightly more conservative in predicting longer distances to meet the 32.2 ^{o} C temperature criterion. However these predicted longer distances remain well within the proposed 62 meter mixing zone for Outfall 001. To provide a feel for VISUAL PLUMES and JETLAG results, Figures 1 and 2 present the vertical plane trajectories for the 5.3 meter below the surface discharge port cases without and with ambient current using JETLAG. JETLAG results are presented due to JETLAG having more refined graphics capabilities than the VISUAL PLUMES software. JETLAG predicts the possibility for the discharge plume to come into contact with the bottom but only when considering the edge of the plume perimeter. Both models do predict the plume to turn and dissipate with both ambient distance and current conditions

4.0 Model Results for FSRU Outfall 002

The discharge from FSRU Outfall 002 was simulated with only JETLAG due to limitation with CORMIX and VISUAL PLUME handling buoyancy dominated, downward discharge angles. The results of the JETLAG simulations are shown in Table 5. For the no ambient current scenario, the plume is buoyancy dominated and immediately re-orients from a downward to an upward trajectory as shown in Figure 3. The temperature criterion is met at a horizontal distance of 1.9 meters and a vertical distance of 5.1 to 7.2 meter below the surface for the 6.3, 7.35, and 8.4 meter port discharge depths. In actuality, the near vertical plume from Outfall 002 would hug the vessel hull as it rises to the surface. For the case with a nominal ambient current (0.1 m/sec) the plume is slightly deflected into the horizontal plane due to the influence of the ambient current momentum (see Figure 4) and the increased entrainment reduces the horizontal distance to which the criteria is met is 0.5 meters or less. Depths below the water surface at which the criteria are met range from 6.7 to 8.8 meters. The plume trajectory ends below the surface where the plume density and ambient density differ by less than one per cent. The plume with ambient current will also in actuality hug the vessel hull. In all cases the temperature criterion is met well within the proposed 17.5 meter mixing zone.

5.0 Model Results for LNGC Thermal Discharge

The only information for the LNGC thermal discharge is a discharge rate of 2.72 cm/sec and a projected temperature rise of 3° C based on the characteristics of the Jordan Cove Project (FERC, 2009). In the absence of available data on port characteristics for the LNGC, the port diameter, orientation and discharge depths for FSRU Outfall 001 were used. Due to the 32 % higher discharge rate and four fold reduction in buoyancy, the jet plume will impact the bottom for all discharge depths. Since the CORMIX model does not provide complete information for a bottom impact situation, the LNGC thermal discharge was modeled only with VISUAL PLUMES and JETLAG.

Results for the VISUAL PLUMES simulations are summarized in Table 6. VISUAL PLUMES first output is the horizontal distance to sea bottom impact. Since the corresponding vertical positions are above the bed, it is inferred that bottom impact will be along the plume edges similar to JETLAG results for the FSRU predictions. Temperatures at the point of bottom impact are much lower than the discharge temperature of 32.6° C and the criterion temperature of 32.2° C. Horizontal distances to bottom impact range from 9.4 to 12 meters, well within the proposed 62 meter mixing zone based to 50 times the port length scale.

To get a more detail resolution of the jet-plume and the actual locations at which the temperature criterion will be met, JETLAG was used to simulate the 6 discharge scenarios summarized in Table 7. For the no ambient flow scenario, the temperature criterion is met at a horizontal distance of 0.82 meters. Corresponding depths at which the criteria are met range from 6.1 to 8.2 meters for discharges depths ranging from 5.3 to 7.4 meters. For the scenarios with a 0.1 m/sec ambient current, the temperature criterion is met at a horizontal distance of 0.41 meters (Table 7). Depths at which the temperature criterion are met range from 5.7 to 7.8 meters for discharge depths ranging from 5.3 to 7.4 meters. Graphical results corresponding to the 5.3 meter discharge depth case without and with an ambient current are shown in Figures 5 and 6, respectively. Due to the high moment flux and small temperature rise, the 32.2° C temperature criterion is met within less than a port diameter distance from the vessel discharge.

6.0 Potential for Bed Scour

The VISUAL PLUMES simulation for FSRU Outfall 001 did not predict interaction of the discharge plume with the sea bottom. JETLAG predicted some potential for interaction of the FSRU and LNGC plume edge with the sea bottom for the main condenser outfalls for all port depths. The 7.4 meter discharge depth cases for the LNGC thermal discharges resulted in the highest jet velocities at the point of bottom impact. Since the ambient current entrains more slower moving ambient water as well as deflecting the plume more to the horizontal, the case with no ambient current results in the higher impact velocity of 0.46 meters/sec. Assuming a conservatively stress coefficient of 0.025, the 0.46 meter/sec velocity produces a bed stress of 0.53 Pa (Newtons/square meter) and a corresponding shear velocity of 0.023 m/sec. For sand beds, the stability of the bed can be determined using the Shield's criteria for incipient motion (Garcia, 2008). For the 0.023 m/sec shear velocity, the stable sediment grain size is approximately 1 mm, which is the boundary between coarse and very coarse sand. When the first discharge of the plume occurs, material finer than 1 mm, if present, will be eroded with coarser material transported as bed load and finer material as suspended load. However with the initial removal of the fine material, the bed will be eventually be sorted and armor as the concentration of coarse material at the be surface increases.

7.0 Summary and Conclusions

The simulations and analysis summarized in this memoranda indicate that the 32.2° C maximum temperature criteria will be met for the FSRU and LNGC thermal discharges well within calculated mixing zones based on the 50 times the port length scale (square root of port area) US EPA guidance (US EPA 1991). This conclusion is strongly supported by the unique approach of using three different buoyant jet models: CORMIX, VISUAL PLUMES and JETLAG. The unique characteristic of the discharges and ambient conditions results in FSRU Outfall 001 and the LNGC thermal discharge strongly interacting with the bottom or impacting the bottom. This interaction or potential for impact was not adequate in projecting bottom trajectory. For these two discharges, the CORMIX model did not provide the required level of results and the VISUAL PLUMES and JETLAG models were applied and yielded consistent results. For the initially downward but rapidly bending FSRU Outfall 002, the Lagrangian formulation of JETLAG provided detailed information which could not be obtained from the other two models.

For the FSRU and LNGC, the achievement of the 32.2 °C temperature criterion was attained well within the predicted mixing zones for all the modeled outfalls. The potential for interaction of the plumes with the sea bottom could result in some re-suspension and sorting of the bottom sediments. This effect however would be dependent upon the grain size of sediments present and the plume velocity at impact. Fine grained sediments such as silts and clays would be entrained and re-suspended in the water column during the early the initial start-up of the FSRU and LNGC operations. Available data for the sediments at the proposed the offshore terminal location indicate a mixture of coarse and shell fragments of a texture and grain size less prone to erosion based on project plume velocities near the bottom. The discharge velocity selected for the modeling effort chose a conservative value (the higher end of the range observed in similar vessels) and thus affords some degrees of conservativeness in the plume modeling exercise in predicting the interaction of thermal plume with the sea bottom.

Table 1. FSRU and LNGC Discharge Properties

Vessel Discharge Property	FSRU Discharge 1 Outfall 001	FSRU Discharge 2 Outfall 002	LNGC Thermal Discharge
Flow Rate, (cubic meters per second)	2.06	0.26	2.72
Discharge Port Diameter, (meters)	1.4	0.4	1.4
Port Area, (square meters)	1.54	0.126	1.54
Length Scale (square root of area), (meters)	1.24	0.35	1.24
Port Discharge Velocity, (meters/se)	1.34	2.06	1.34
Discharge Angle from Horizontal, (degrees)	-45	-45	-45
Discharge Angle form Ambient Flow, (degrees)	90	90	90
Discharge Depth Range, (meters)	5.3 – 7.4	6.3 -8.4	5.3 – 7.4
Discharge Temperature Above Ambient (^{o} C)	12	12	3
Maximum Ambient Temperature, (^{o} C)	29.6	29.6	29.6
Water Depth, (meters)	19.2	19.2	19.2
Mean Tidal or Ambient Current, (meters/sec)	0.10	0.10	0.10
Not to Exceed Temperature Criteria, (^{o} C)	32.2	32.2	32.2
EPA Guidance Mixing Zone (50 x length scale), (meters)	62	17.5	62

Table 2. Locations at Which Temperature Criterion Are Met for FSRU Outfall 001 Based on the CORMIX Model

Case	Discharge Depth, (meters)	Ambient Velocity, (meters/ Second)	Criteria (32.2^o C / 90^o F) or Bottom Impact Temperature, (^{o} C)	Horizontal Distance to Meet Criteria or to Bottom Impact, (meters)	Depth to Meet Criteria or to Bottom Impact, (meters)
1	5.3	0	32.2	42	19.2*
2	6.35	0	32.2	42	19.2*
3	7.4	0	na	na	na
4	5.3	0.1	32.2	28	19.2*
5	6.35	0.1	32.2	28	19.2*
6	7.4	0.1	na	na	na

* Bottom impact with no intermediate trajectory information provided

Table 3. Locations at Which Temperature Criterion Are Met for FSRU Outfall 001 Based on the VISUAL PLUMES UM3 Model

Case	Discharge Depth, (meters)	Ambient Velocity, (meters/ Second)	Criteria (32.2° C / 90° F) or Bottom Impact Temperature, (° C)	Horizontal Distance to Meet Criteria or to Bottom Impact, (meters)	Depth to Meet Criteria or to Bottom Impact, (meters)
1	5.3	0	32.2	12.2	9.6
2	6.35	0	32.2	12.2	10.7
3	7.4	0	32.2	12.2	11.8
4	5.3	0.1	32.2	6.3	9.6
5	6.35	0.1	32.2	6.3	10.8
6	7.4	0.1	32.2	6.3	11.7

Table 4. Locations at Which Temperature Criterion Are Met for FSRU Outfall 001 Based on the JETLAG Model

Case	Discharge Depth, (meters)	Ambient Velocity, (meters/ Second)	Criteria (32.2° C / 90° F) or Bottom Impact Temperature, (° C)	Horizontal Distance to Meet Criteria or to Bottom Impact, (meters)	Depth to Meet Criteria or to Bottom Impact, (meters)
1	5.3	0	32.2	15.2	15.5
2	6.35	0	32.4	13.1	16.0
3	7.4	0	32.6	11.5	16.4
4	5.3	0.1	32.2	8.6	12.4
5	6.35	0.1	32.2	8.6	13.5
6	7.4	0.1	32.2	8.6	14.5

Table 5. Locations at Which Temperature Criterion Are Met for FSRU Outfall 002 Based on the JETLAG Model

Case	Discharge Depth, (meters)	Ambient Velocity, (meters/ Second)	Criteria (32.2° C / 90° F) or Bottom Impact Temperature, (° C)	Horizontal Distance to Meet Criteria or to Bottom Impact, (meters)	Depth to Meet Criteria or to Bottom Impact, (meters)
1	6.3	0	32.2	1.9	5.1
2	7.35	0	32.2	1.9	6.2
3	8.4	0	32.2	1.9	7.2
4	6.3	0.1	32.2	0.5	6.5
5	7.35	0.1	32.2	0.5	7.6
6	8.4	0.1	32.2	0.4	8.8

Table 6. Locations at Which Temperature Criterion Are Met for LNGC Thermal Discharge Based on the VISUAL PLUMES UM3 Model

Case	Discharge Depth, (meters)	Ambient Velocity, (meters/ Second)	Criteria (32.2° C / 90° F) or Bottom Impact Temperature, (° C)	Horizontal Distance to Meet Criteria or to Bottom Impact, (meters)	Depth to Meet Criteria or to Bottom Impact, (meters)
1	5.3	0	32.2	<12.0*	<16.4*
2	6.35	0	32.2	<11.0*	<16.4*
3	7.4	0	32.2	<10.0*	<16.4*
4	5.3	0.1	32.2	<9.4*	<14.8*
5	6.35	0.1	32.2	<9.4*	<14.8*
6	7.4	0.1	32.2	<9.8*	<15.4*

* Trajectory too coarse to provide near port information

Table 7. Locations at Which Temperature Criterion Are Met for LNGC Thermal Discharge Based on the JETLAG Model

Case	Discharge Depth, (meters)	Ambient Velocity, (meters/ Second)	Criteria (32.2° C / 90° F) or Bottom Impact Temperature, (° C)	Horizontal Distance to Meet Criteria or to Bottom Impact, (meters)	Depth to Meet Criteria or to Bottom Impact, (meters)
1	5.3	0	32.2	0.82	6.1
2	6.35	0	32.4	0.82	7.2
3	7.4	0	32.6	0.82	8.2
4	5.3	0.1	32.2	0.41	5.7
5	6.35	0.1	32.2	0.41	6.8
6	7.4	0.1	32.2	0.41	7.8

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Figures

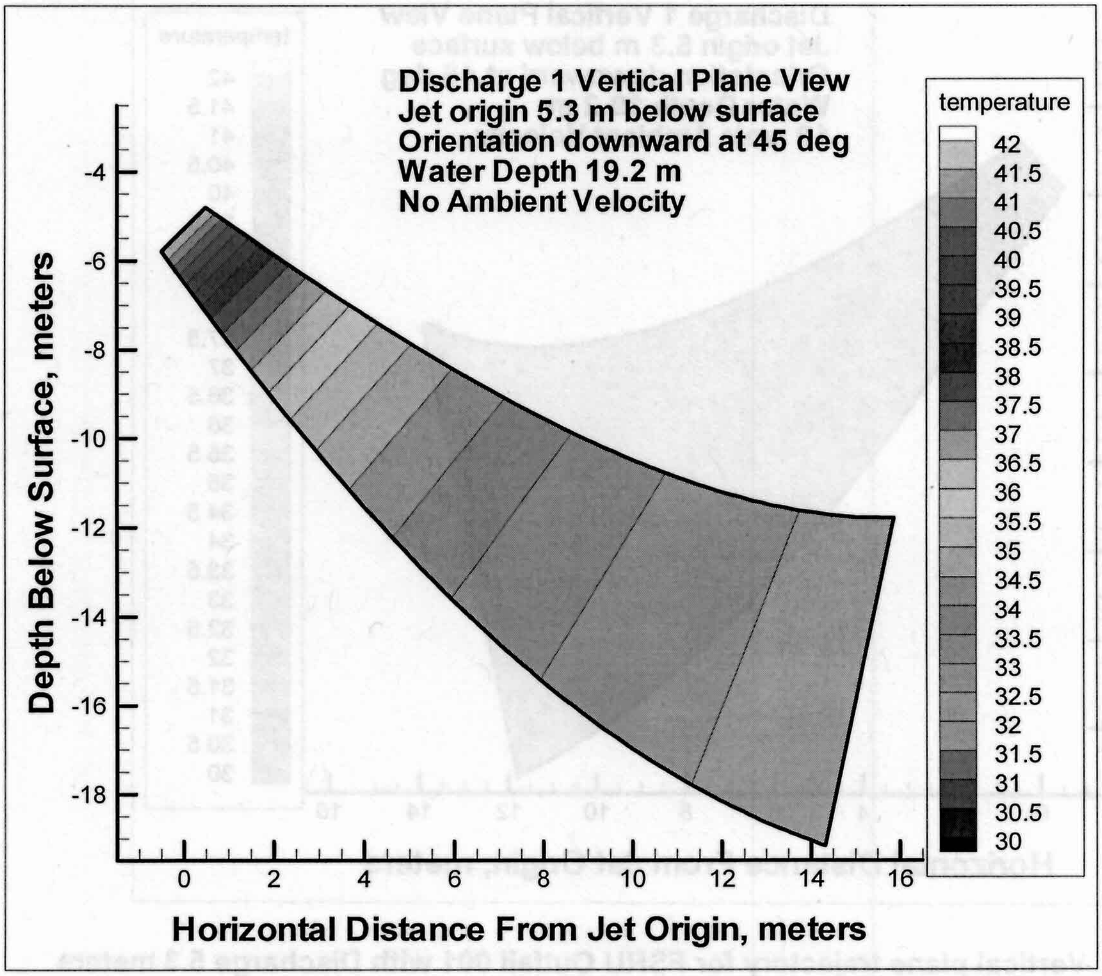

Figure 1. Vertical plane trajectory for FSRU Outfall 001 with Discharge 5.3 meters below surface and no ambient current

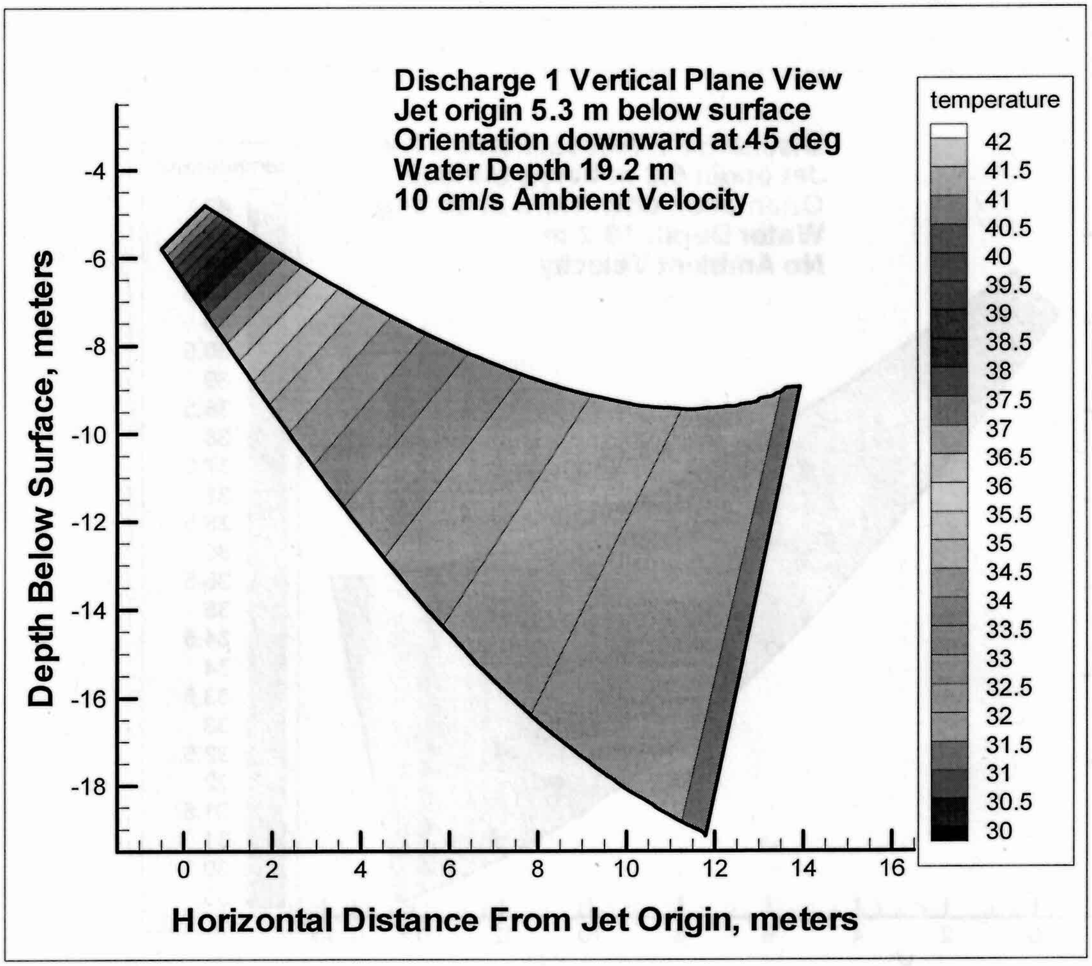

Figure 2. Vertical plane trajectory for FSRU Outfall 001 with Discharge 5.3 meters below surface and a 0.10 m/s ambient current

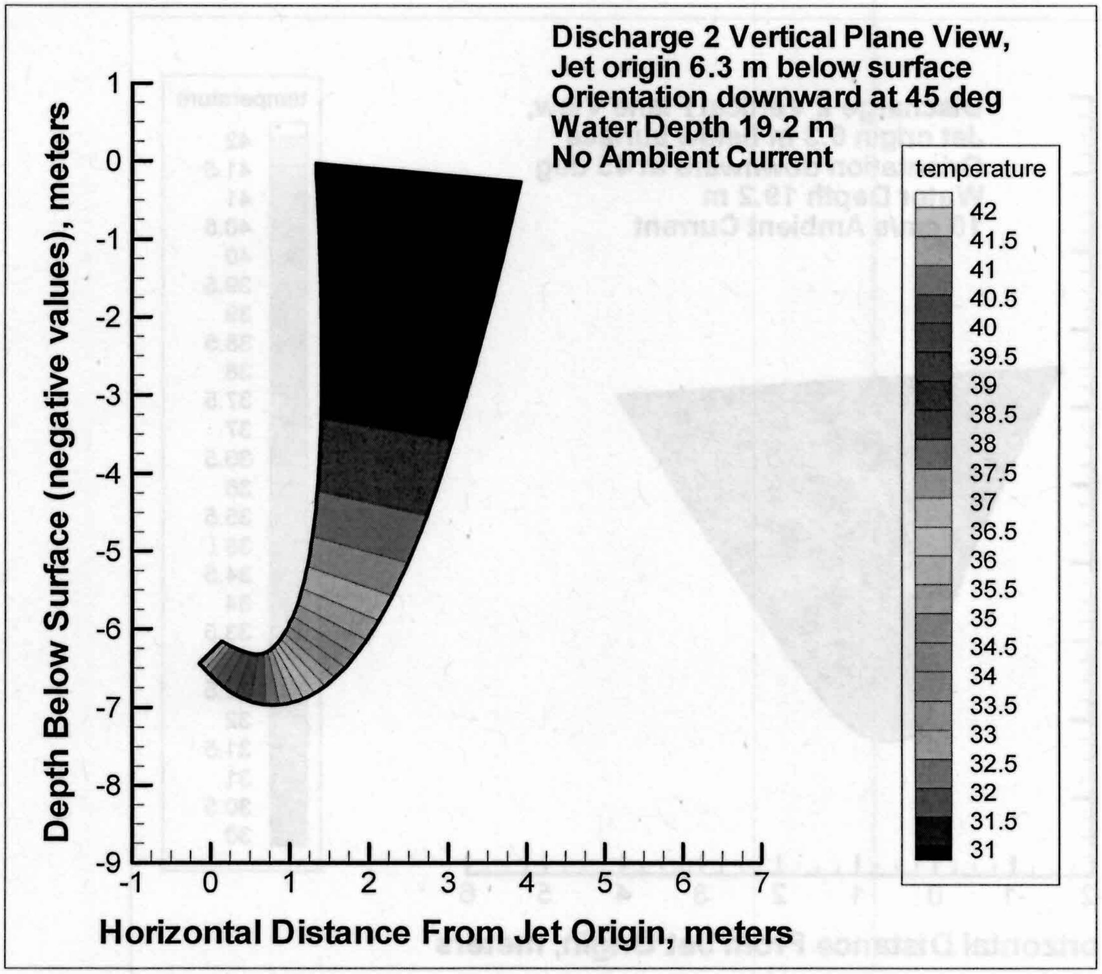

Figure 3. Vertical plane trajectory for FSRU Outfall 002 with Discharge 6.3 meters below surface and no ambient current

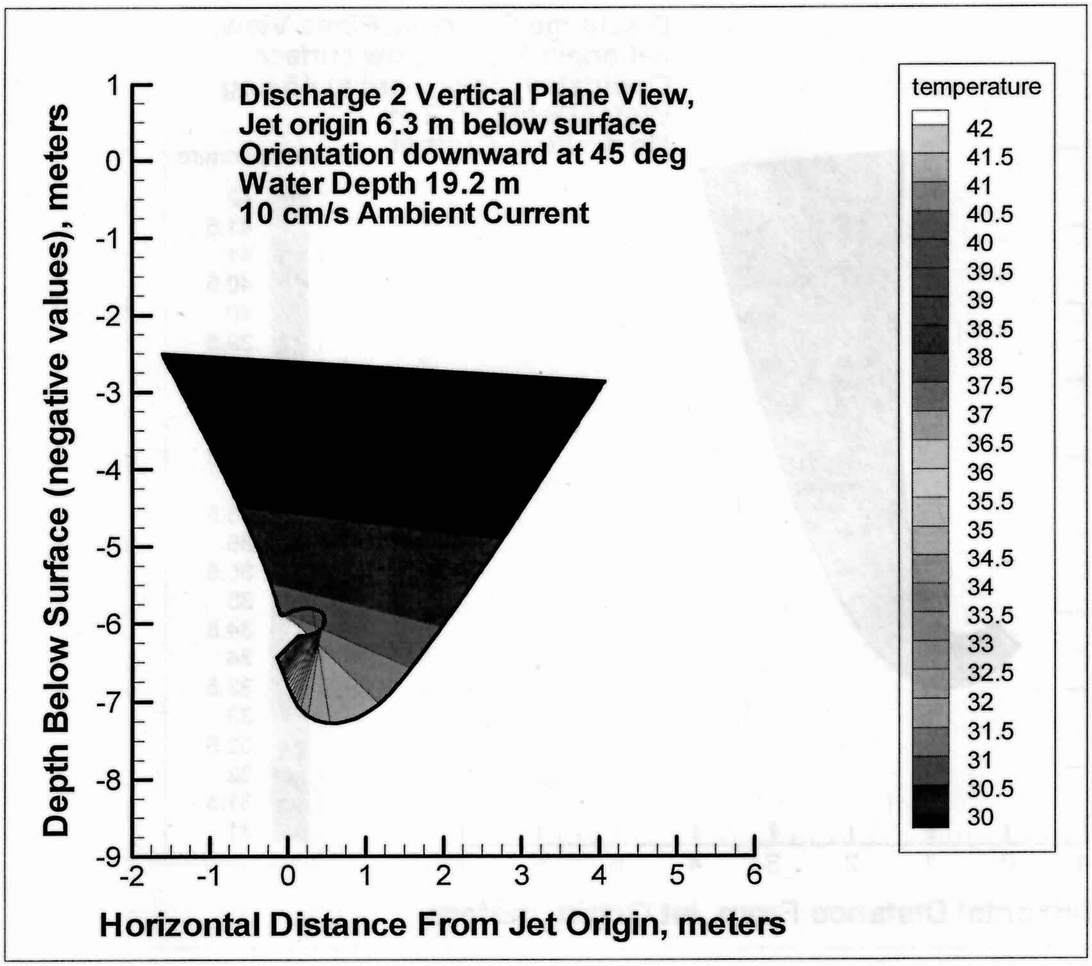

Figure 4. Vertical plane trajectory for FSRU Outfall 002 with Discharge 6.3 meters below surface and a 0.10 m/s ambient current

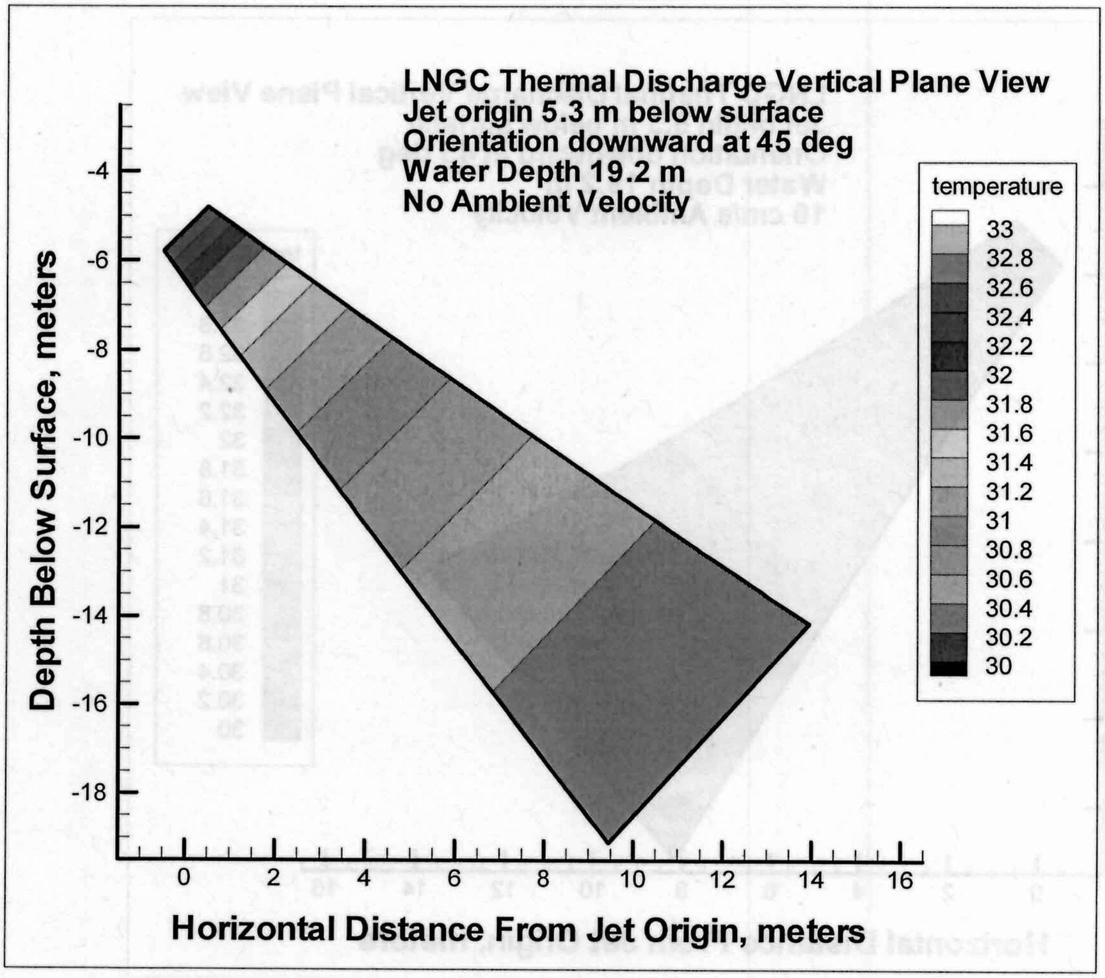

Figure 5. Vertical plane trajectory for LNGC Thermal Discharge with Discharge 5.3 meters below surface and no ambient current

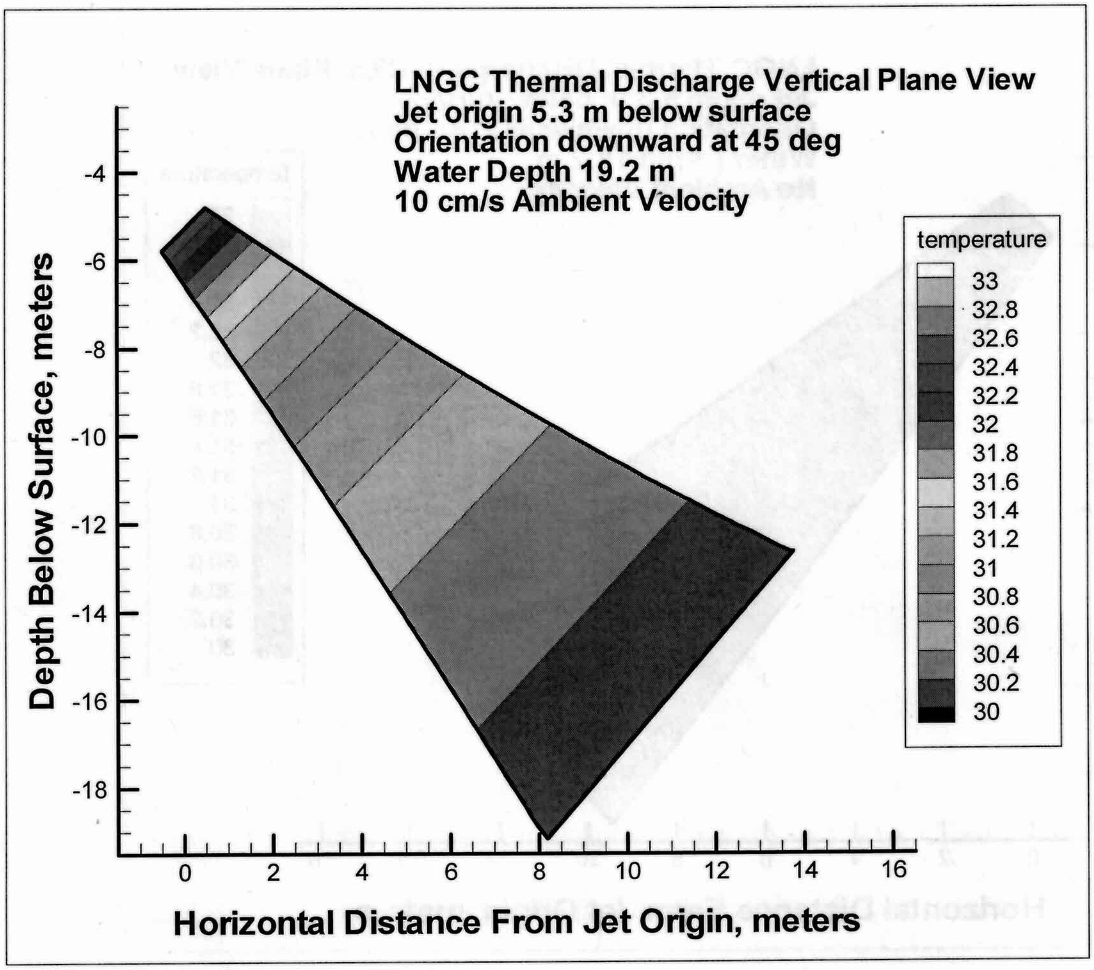

Figure 6. Vertical plane trajectory for LNGC Thermal Discharge with Discharge 5.3 meters below surface and a 0.10 m/s ambient current

Appendix 1 VISUAL PLUMES Output Files

```
FSRU 001 case 1

/ Windows UM3. 6/29/2012 11:10:06 AM
Case 1; ambient file c:\plumes\VP plume 0.001.db; Diffuser table record 1: --
-------------------------------
      Depth    Amb-cur    Amb-dir    Amb-sal    Amb-tem    Amb-pol      Decay
Far-spd    Far-dir    Disprsn
          m        m/s        deg        psu          C      kg/kg        s-1
m/s        deg   m0.67/s2
        0.0        0.0       90.0        0.0       29.6        0.0        0.0
0.0        0.0        0.0
       19.2        0.0       90.0        0.0       29.6        0.0        0.0
0.0        0.0        0.0
   P-dia  P-elev V-angle H-angle   Ports AcuteMZ ChrncMZ P-depth Ttl-flo Eff-
sal     Temp Polutnt
     (m)     (m)   (deg)   (deg)      ()     (m)     (m)     (m)  (m3/s)
(psu)      (C)  (kg/kg)
     1.4    13.9   -45.0     0.0     1.0    62.0    62.0     5.3    2.06
0.0     41.6  1000.0
Froude number:        5.566
           Depth  Amb-cur     P-dia  Polutnt    Dilutn    x-posn    y-posn
Step         (m)    (m/s)       (m)  (kg/kg)        ()       (m)       (m)
   0         5.3      0.0       1.4   1000.0       1.0       0.0       0.0; max
dilution reached
Potential for more dilution
 100        10.6      0.0     6.288    263.5     3.783     8.749       0.0 104
10.61        0.0    6.396     259.3    3.844     9.003       0.0
 107       10.61      0.0     6.472    256.4     3.888     9.191       0.0 152
9.912        0.0    7.191     219.0     4.55     11.97       0.0
 200       6.341      0.0     7.826    164.6     6.052     15.92       0.0 220
1.813        0.0    8.595     127.5    7.816     18.57       0.0
```